SCIENTIFIC AMERICAN

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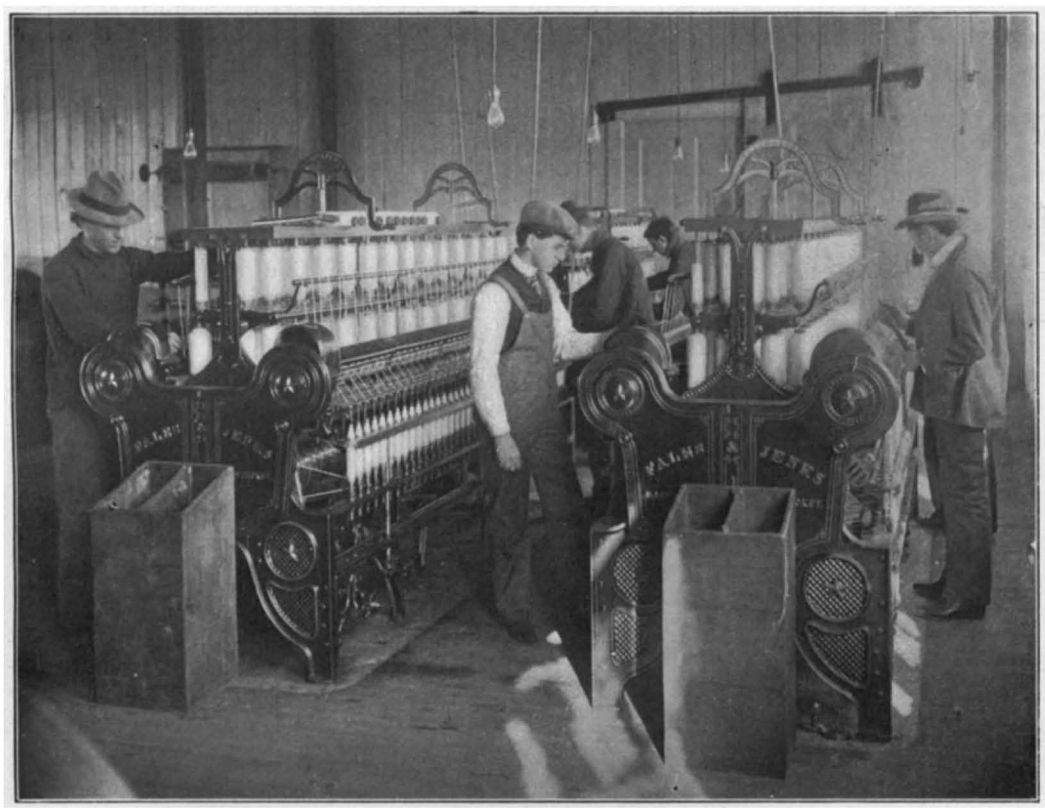
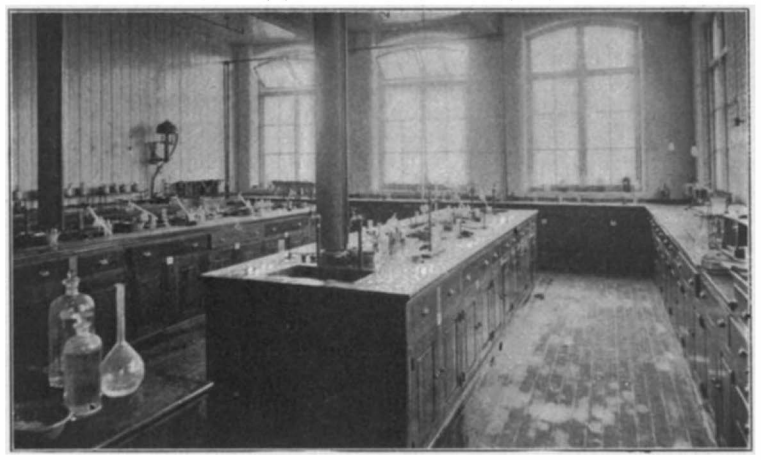


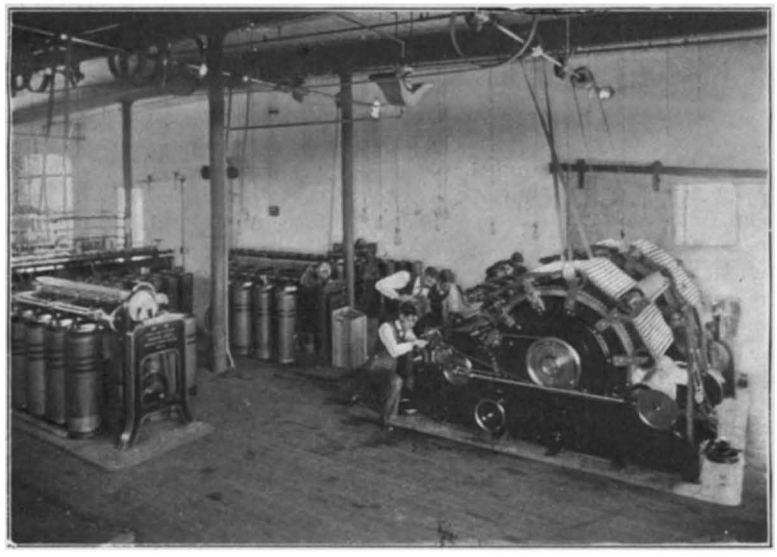
At the Ring-Spinning Frames.

Power Weaving.

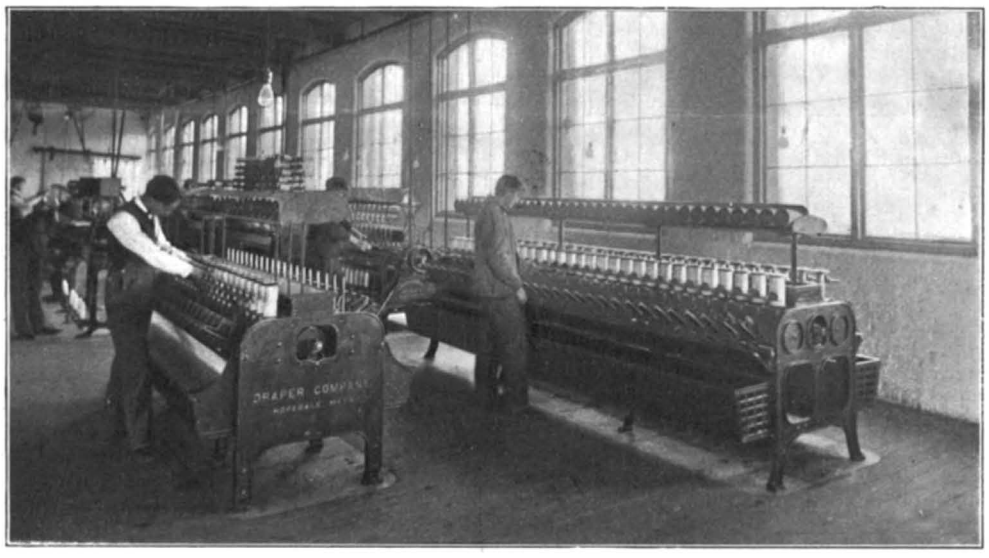
Dye House.



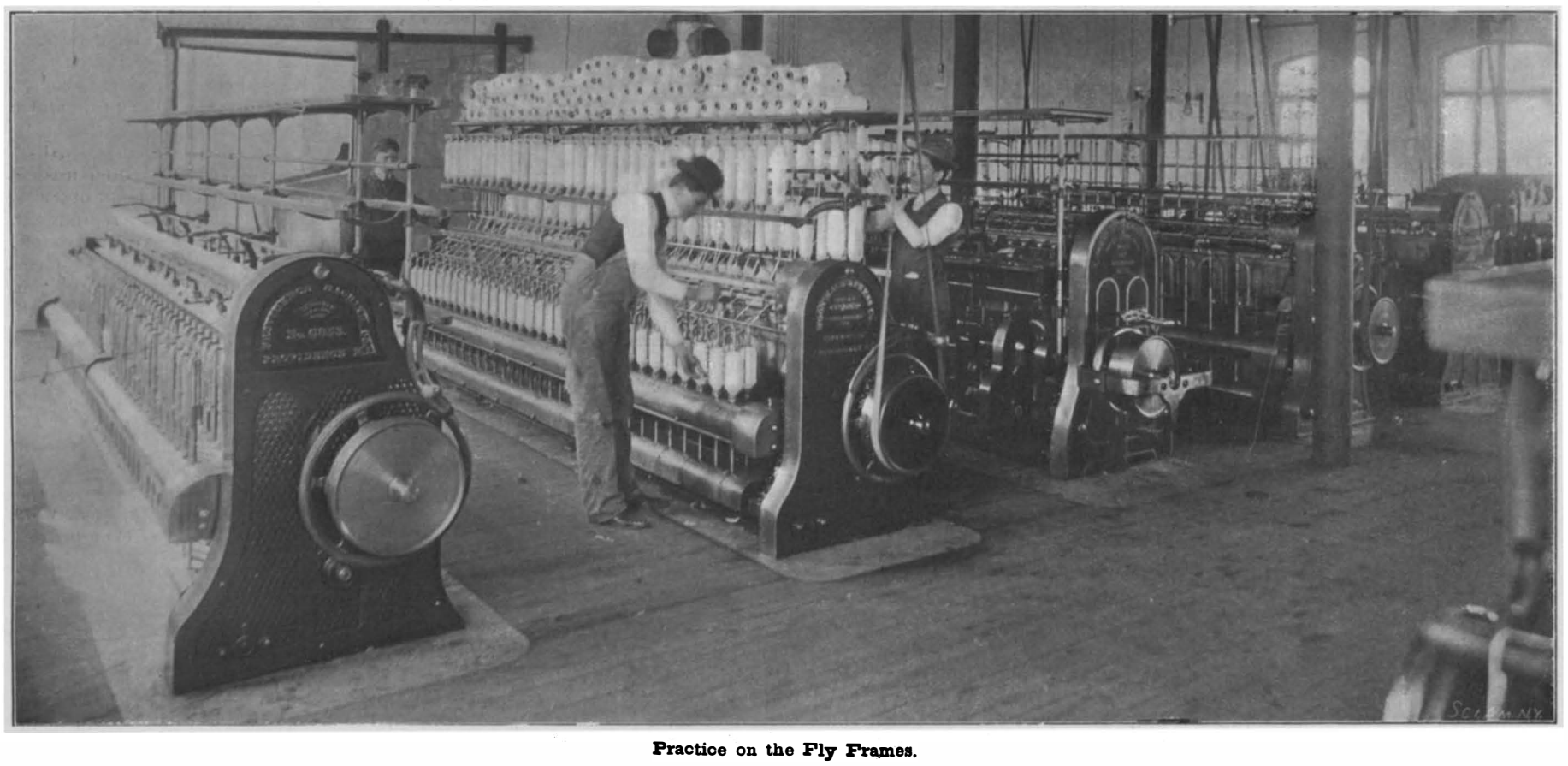
Dyeing Laboratory.



Card-Grinding Practice.

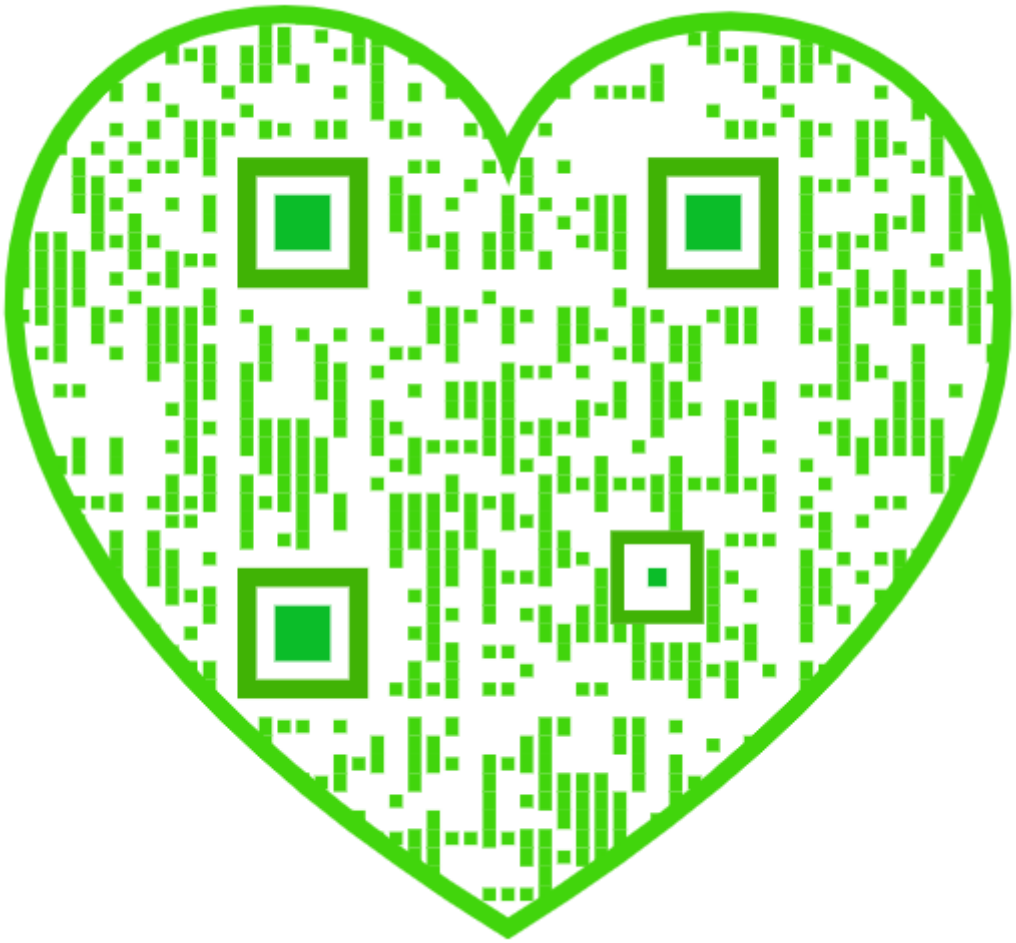


Work at the Spoolers, Twisters, and Cone Winder.



Practice on the Fly Frames.

COTTON TRADE SCHOOLS IN THE SOUTH.—[See page 342.]



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NEW YORK, SATURDAY, JUNE 2, 1900.

PRELIMINARY HEARING OF THE PRESIDENT'S CANAL COMMISSION.

The Senate has shown a proper appreciation of the gravity of the Isthmian Canal question by refusing to take up the bill for the immediate construction of the Nicaragua, which was passed in such unseemly haste by the House. Its refusal to enter upon a premature debate was no doubt largely due to facts brought out at a preliminary hearing of the engineers of the canal commission by the Senate Committee on Interoceanic Canals, of which Mr. Morgan is chairman.

Although the members of the commission very properly refused to commit themselves, at the present stage of their incomplete investigations, to any exact statement of the relative cost or feasibility of the Nicaragua and Panama routes, enough information of a general nature was presented to prove that the question of the best route is yet an open one, and that the passage of the Hepburn bill by the House was precipitate, and contrary to the dictates of prudence and forethought by which the discussion of this great national project should be governed.

It is impossible to review the interesting report of this hearing at any length, and it must suffice to quote a few of the salient features of the testimony. In the first place, then, it is the opinion of every member of the commission that both canals are feasible; and while no exact estimate of cost was given, Col. Ernest stated that in his opinion "it would cost less money to finish the Panama Canal than to build the Nicaragua Canal." There was a consensus of opinion that the present plans of the French engineers had solved the three great problems of the Culebra cut, the summit water supply, and the control of the Chagres River, and the impression produced upon the committee was voiced by Senator Sewell (of the committee), who said: "We have been educated for the last ten years with the idea that the Panama Canal was an impracticable thing, and it has only been within the last month or two that we have heard from your commission, not officially, but from individual members, that it is an open question whether the Panama Canal could not be finished just as cheaply as the Nicaragua Canal could be built."

On the question of harbors, Admiral Walker stated that it would be easier to make a harbor at Colon (Panama) than at Greytown (Nicaragua), while at the Bay of Panama, on the Pacific, there would be "really no necessity for a harbor." Speaking on the same subject, Mr. Morison testified that the construction of Greytown Harbor (Nicaragua) would be a "work of unusual difficulty and magnitude," and in common with the great dam across the San Juan, "must be considered a very great obstruction in an engineering sense." At the same time he considers that these engineering difficulties can be surmounted, since "everything is feasible in construction to an engineer, provided he has sufficient time and money."

The imperative necessity of waiting for the report of the commission is shown by the fact that, as regards Nicaragua, the Walker survey, according to Colonel Hains (a member of the Walker commission), was a "paper location," whereas the present commission are "locating the canal on the ground itself." Hence it is not surprising that the new estimate of cost will be greater than that of the Walker commission. The more rigid examination has revealed among other things the fact that the dam on the San Juan will be a far more costly affair than was supposed. According to Mr. Morison, it will be necessary to go down 100 feet below the low water level of the river to secure rock foundation, and work at this depth will involve the use of the pneumatic process. This is deeper than the foundations of the Mississippi bridge at Memphis, which measured 60 by 100 feet. As the foundation of the dam will be 120 feet wide by 1,500 feet long, we can appreciate Mr. Morison's statement that "it is going to cost an enormous amount of money."

We could quote at further length from this report; but we think enough has been said to show that the question as to which is the best canal for the United States Government to construct and own is still very much "in the air;" especially when we bear in mind that other possible routes, such as that at Atrato, are also under consideration and may yet prove to have superior advantages over the two great rival routes above considered.

MUTUALLY PROFITABLE.

We have on more than one occasion referred to the frankness, unusual in transportation companies of this character, which characterizes the annual statements of the operation of the Metropolitan Street Railway Company of this city; and the figures disclosed by President Vreeland at a recent meeting of the shareholders are, as usual, full of valuable and instructive facts which have a general public interest. The operations of this, the largest street railway company in the world, are shown by these statistics to have been as profitable to the general public as they have been to the shareholders themselves, and this result is an endorsement of the liberal policy which, with few exceptions, has governed the attitude of the company toward the public.

The following is a digest of the comparative figures given by the president for the years 1894 and 1899:

	1894	1899
Miles operated track.....	131	224
Car mileage.....	17,383,590	41,760,856
Gross earnings.....	$5,398,465	$13,525,485
Per cent operating expenses.....	59·7	48·7
Divided profits	$328,000	$2,471,675

It will be noticed that although the length of the track operated increased in this period but sixty per cent, the mileage increased in the same period about two hundred and fifty per cent, while the gross earnings increased at the same rate, and the profits at the rate of eight hundred per cent. Looking at these enormous profits one would naturally be prepared to find that they were the outcome of a policy in which the general public was made to suffer for the benefit of the corporation. So far is this from being the case, however, that by virtue of a generous system of transfers, a passenger can ride continuously for a distance of about fifty miles on the different lines of the system for one five cent fare; and the public has shown its appreciation of this convenience by taking transfers during the year 1899 to the astonishing total of 128,365,161.

The company point with commendable pride to the fact that under the old system of separately owned and operated systems, the same amount of transportation would have cost the traveling public an additional sum of $6,418,258.

As a matter of fact it will be apparent at once to all students of the economics of transportation that this sum would never have been expended by the public under the old system. It is the consolidation of roads under one management, and the high state of efficiency to which the roadbed, rolling stock, and motive power have been brought, that enable the street railways of New York not only to carry passengers at a much lower rate per mile, but to do so with vastly increased profits to the shareholders; while the cheapening of transportation has served, in its turn, to increase the amount of travel by 250 per cent. The recent acquisition of the vast system of the Third Avenue Railway Company places the whole of the railroads of New York under one management, and as this consolidated system will be advantageously placed with regard to the city's underground system, there is no doubt that a further extension of the system of transfers will be made by which the efficiency of both the above and underground lines will be greatly improved.

CONGRESS AND THE PNEUMATIC DISPATCH SYSTEM IN THIS CITY.

Chiefly because of certain irregularities which were stated to have occurred in connection with the granting of former appropriations for the Pneumatic Postal Tube System in this city, Congress was disposed at first peremptorily to refuse the requested appropriation for this year; and has only now given a reluctant consent, coupled with the stipulation that no further extensions of the system are to be sanctioned.

Opposition to the granting of the appropriation was based upon some very explicit statements, to the effect that persons financially interested in the Dispatch System had held positions in a previous year which gave them a hand in the unloosing of the government purse-strings when the question of appropriations was passed upon.

The SCIENTIFIC AMERICAN is not concerned in this aspect of the question further than to say that if the facts are as stated, this journal is heartily in sympathy with the motive which suggested the withholding of further appropriations; for every blow at the iniquities of the "spoils system" brings us nearer to that day when the word Congress shall be suggestive of an integrity that is spotless and unassailable. At the same time we think that if the appropriations had been refused, Congress would have shown more zeal than discretion; for in its desire to punish a few individuals, it would have seriously crippled the New York Post Office by depriving it of its most efficient system of delivery.

The pneumatic postal service of this city, a description of which appears in the SCIENTIFIC AMERICAN of December 11, 1897, was installed after the practicability of the system had been demonstrated by the postal authorities in London, Paris and Berlin, and by the successful operation of a plant erected by an American company in Philadelphia. The American plant embodied all the improvements suggested by past experience, and surpassed all previous installations in the fact that its capacity was trebled, and a larger class of mail matter was eligible for transmission. The New York system, which includes a line of tubes from the general Post Office downtown to the banking district, uptown to Forty-second Street and across the Brooklyn Bridge to Brooklyn, may well stand upon its record as gathered from the report of the postmaster at New York to the postmaster-general. From this report we learn that on the first named of the above routes the tube has saved over 10,000 miles of wagon service annually, on the second-named, 48,312 miles; while the branch across the Brooklyn Bridge has reduced the wagon mileage by 18,000 miles. The time occupied by the mails in transit has been surprisingly reduced; in the case of the Brooklyn delivery, according to the report, mails which took twenty-five minutes by wagon are now carried in three minutes through the tubes, while "mails are now delivered with ease, on the first round of carriers all over the city, that heretofore were delivered only by a constant struggle with delayed trains, broken-down wagons, and careless drivers."

Quotations from this report might be multiplied, showing that, whatever doubtful influences may or may not have been at work in connection with the matter of appropriations, the new system of postal delivery is thoroughly efficient and a boon to the general public. Congress, in its determination to administer a stinging rebuke, has apparently lost sight of this fact; with the result that the punitive measures proposed would have fallen heavily upon that very public whose interests it is desired to protect. Evidence of this is found in the agitation which was immediately started among the merchants and business associations of this city to loosen the deadlock, and preserve an institution which has proved its right to become a permanent feature of our system of postal delivery.

DEVELOPMENT OF COLOR-PHOTOGRAPHY.

In a communication made to the Académie des Sciences, M. Graby gives an account of a method of color-photography, by which he has succeeded in obtaining an approximation to the natural colors. After having made a series of prints upon a paper containing subchloride of silver and bichromate of potassium, he found that in some cases prints were obtained which gave an appearance of the natural colors. He came to the conclusion that since this effect is obtained by the violet-blue of the subchloride and the orange of the bichromate, the next step would be to make a separate print of the blues and violets upon a blue paper and one of the oranges and reds upon an orange paper, and that these prints, when superposed, would give more or less the desired effect. His method of working is to make the first exposure upon a plate sensitive to orange, behind a red screen; the second exposure is made with a screen of bluish-green, upon a plate sensitive to the blues and greens; by using a stereoscopic camera, the two exposures may be made at the same time, besides obtaining relief.

The first plate is printed upon the ordinary ferroprussiate, or blue print paper, the second upon a chloride of silver paper, which is not toned, but merely fixed in the hypo. bath and washed, giving thus an orange-brown color. The two prints are pasted upon a stereoscope card and viewed through a stereoscope, a red screen being placed before the blue print and a blue screen before the orange. In this case the colors of the object are seen with a greater or less approximation, and if a stereoscopic camera has been used at first, relief is also given. A remarkable point observed is the brilliancy with which the metals are reproduced; thus in the case of gilding, the color is not merely yellow, but a fine metallic luster is given. This process is one of great simplicity, as it requires but two exposures and two prints, which are made without toning. By making one of the prints transparent the colors may be obtained by superposing one on the other. This process is now in an experimental stage, and is capable of further improvement to obtain a close approximation to the natural colors; it has the disadvantage of not reproducing the reds or violets to any great extent, but as there are many subjects which do not contain these colors, the process may be used to advantage in certain cases. M. Graby states that he is also at work upon a process by which he uses but one exposure and one photographic print.

THE AMERICAN TROTTER ABROAD.

The superiority of the American trotting horse abroad has become so well established in the last few years that European breeders have sent agents to this country to study our methods of breeding, and in Germany and France the local horse-breeders have induced their governments to place an embargo on fur-

ther importations. Two years ago the American trotter went abroad to enter the races in various parts of Europe, and after winning in dozens of important contests their virtues become fully recognized. The Russian government imported several thousand for breeding purposes and established an American trainer and breeder in the Imperial stud. In Austria wealthy lovers of horse flesh paid from five to ten thousand dollars apiece for American trotters, and in London similar high prices were offered for exceptionally fine American trotters.

In the international races held at Nice the American horses won nearly all the medals and money. Some of them were classed as American-bred horses, but owned by Europeans. This condition of affairs was painfully similar in other races held on the Continent, and while admiration was felt for the American trotters in some quarters, their unfailing success caused envy. The local trainers felt they had no chance of winning in the race. In Russia, the American-bred trotter is now handicapped in all races, the American breeder has been dismissed from the Imperial stud, and the importations of further American horses stopped. In nearly all of the Continental races the American trotters have to enter under such odds that there is no possibility of their winning.

But while local breeders can manage the racing associations so that the American trotters cannot win when pitted against their horses, they cannot besmirch the enviable records and reputation that our trotters have established. Their virtues are so well known that the demand for these animals by prominent European racing men is extensive, and to-day this country is supplying more trotting horses for the European market than any other. Our export trade in horses reached its minimum in 1894, when the bicycle and trolley threatened the doom of the horse, but five years later, in 1899, the pendulum had swung to the other extreme, and our export trade reached its maximum. Last year we exported nearly 100,000 head of horses, and a fair precentage of these were trotters to be used either for racing, coaching, or for the parks. A large number of cavalry horses were also shipped, and these are still going abroad in a continuous stream.

The American trotter, as bred to-day, is the most useful and serviceable horse in the world, and he has outclassed all others at the shows at home and abroad. He is the ideal type of horse, with just sufficient mobility about him to permit the breeders to rear him for a variety of uses. He is bred from fifteen to seventeen hands in height, and from 900 to 1,400 pounds in weight, suitable alike for racing, trotting on the speedway, or for road handling. He is bred to trot from 2:20 to 2:03, and he sells for $600 to $10,000 on the average, not taking into account the extraordinary prices paid for a Maud S. or Sunol. There is a demand to-day in Europe for American trotters that can meet the market requirements at prices ranging from $600 to $10,000. Trotting-bred road horses of extra speed and beauty sell to-day in the London market for $10,000 a pair, and in nearly all instances of such sales the horses are either bred in America or are from American-bred sires.

This condition of our trotting stock abroad has given a new impetus to horse breeding in this country, and there is a revival in the business that promises well for the future. The present scarcity of good salable horses is forcibly contrasted with the condition of the market five years ago. Then the horses in the far Northwest were so plentiful and in such little demand that they were left by the farmers to starve on the range. On the great ranges of Texas, California, Oregon, and Dakota the stallions were shot to stop the increase, and premiums were even offered for removing the herds. Only recently the Union Pacific Railroad closed a contract to carry from the Oregon ranges some 9,000 head of wild horses to the grain-growing States. The organizers of this movement anticipate making money out of these wild horses when they have been fed and prepared for the market. Instead of the wild horses being a nuisance on the plains to-day, they are in great demand both for export and for home use. This change of condition is partly due to our war in the Philippines. The Pacific coast has been shipping horses to the far East for our soldiers and army transports at the rate of nearly a thousand a month. These half wild horses when broken to the saddle make the best sort of army and cavalry horses. So well is this recognized that both Germany and Russia are now buying American horses for this wing of their armies. The South African war has demonstrated the value of a large cavalry army, and nearly all the European nations are increasing their mounted troopers, with the result that the American horses are in greater demand than ever. Not only are the American trotters and range horses of the West great winners, but we practically have a corner in the horse markets the world. We have the breeding stock, and above all the cheapest ranges and feed in the world. The American breeder can put the products of his stock farms on the European markets at less cost than the local breeders, and his animals will be superior in speed, power, and endurance.

THE JAPANESE GRASSES.

Japan continues to supply us with wonderful products of their gardens, which, through centuries of culture, they have brought to the present high state of perfection. Japanese plums, morning glories, and lawn grasses are now quite common in every orchard or garden, and they are not excelled by anything that the Western nations have been able to produce. The Japanese grasses, or Eulalias, have only been introduced in this country a few years, but wherever planted they receive more than common notice. For ornamental grouping on the lawn there is no palm or plant that quite equals them, not even excepting the celebrated pampas plumes. When once planted these grasses flourish so abundantly that it is a question whether they may not have a commercial value as well as an ornamental one. In Japan they are dried and woven into mats, and if one cares to imitate the Orientals in this respect, durable home mats can easily be manufactured. After the cold weather has killed the graceful stems or the variety of Eulalia known as gracillima, the stems should be cut down close to the ground. This will give stems from five to seven feet in length. After cutting, dry a few days in a cool, shady place, and then weave the mats cross-wise, fastening the ends by tying them under or sewing with a bagging needle and twine. A mat at least six by five feet can be made in this way, and it will be found durable enough to last for a long time. The mats can be made in a short time, and the stalks can be had in abundance.

The Japanese make many ornamental wicker-work articles with the stems of the Eulalias, and if they are properly dried in season, they will prove very stiff and strong. For this work they should be cut in the late fall and dried in the shade where moisture cannot reach them. Ornamental baskets, paper racks and scrap-baskets can be made with the dried stems.

The best Eulalia for this purpose is the variety mentioned above. This variety sends up beautiful stems to the height of six or seven feet in the fall, with stems not much larger around than thick straw. The leaves branch out from these solid stems and widen to about a quarter of an inch. These long graceful blades are of a light green with a light midrib running from top to bottom. In late autumn they produce a light pink plume, which is the flower of the plant; and as the frosts come, the stems and leaves turn to a pretty brown, which they maintain until spring. If the stems are cut off in the late fall, new ones shoot up early the next spring, and another crop as large as the first will follow.

The most commonly known Eulalia is the zebrina. This is a short grass compared to the first, but raised in beds and masses, it gives a pretty effect to the lawn or garden. The pure zebrina has yellow bars across a green blade, but most of the specimens seen in gardens are nearly green. This is due to the fact that the variety has a tendency to revert back to its original type. In order to preserve the variegated nature of the plant the roots that show a plain green foliage must be taken up, and the roots divided which emphasize the yellow bars. In this way the plants can be prevented from degenerating.

The Eulalia japonica variegata is a variety that greatly resembles the old-fashioned ribbon grass, but it is prettier and taller. The green leaves are brightly variegated with white and yellow, which colors do not disappear as the season advances, but remain on the foliage until frost kills the plants. Although fragile in appearance this grass is quite hardy, and does not suffer from our severe winters. A pretty method of planting them is to surround a group of the taller-growing gracillima with a border of the variegata. The former lends support and contrast to the latter, and the two together always make an effective ornament. The variegata is a foot or two shorter in its full growth than the gracillima. The two varieties grow with the greatest freedom, and require next to no care after being planted. They can be made to flourish in clumps or in a scattering row, where each individual stem stands out tall and straight as a reed arrow.

There are infinite uses to which these tall slender grasses may be put. They are not as tough as the Japanese bamboo, but for light work they answer almost the same purpose. We cannot raise the bamboo in this country, but the Eulalias will flourish, and we might endeavor to employ them about the house in useful and ornamental ways.

DEATH OF JONAS GILMAN CLARK.

Jonas Gilman Clark, the founder of Clark University, died at his home at Worcester, Mass., at the age of eighty-five. He was born in 1815. After obtaining a public school education he apprenticed himself to the carriage-makers' business in Boston, and in 1853 he went to California during the gold fever and laid the foundation of his fortune. When he returned East he located in New York, where he amassed a large fortune in the banking business. In 1889 he founded Clark University, in Worcester, Mass., giving it an endowment of $2,000,000. By his death the institution receives his magnificent library of rare and costly books. Clark University is perhaps unique among the educational institutions of the United States. It is devoted entirely to post-graduate studies, and the university has recently celebrated its tenth anniversary.

PARIS EXPOSITION NOTES.

The number of passengers to the Paris Exposition on the opening day was 118,630. In 1889 111,295 were admitted.

The Post Office in the American pavilion will be a valuable object lesson to Europeans as regards the prompt handling of postal matters. It is located on the main floor together with the Bureau of Information, reading and writing rooms. The second floor will be devoted to various State headquarters. The commissions reception room will occupy the third floor, and the fourth floor is given up to the headquarters of juries, delegates, etc.

A large number of fine jewelry exhibits have been placed at the Exposition, and from now on special arrangements have been made to prevent losses by robbery or fire, and a special service has been organized, which is in charge of M. de Balnégre, a former Commissioner of Police. A service of day and night watchmen has been arranged for, and should any of the cases be broken into, or jewelry be stolen from any of the vistors, measures have been taken to have a bell rung as soon as the theft is detected, and the gates of the different buildings are closed at once.

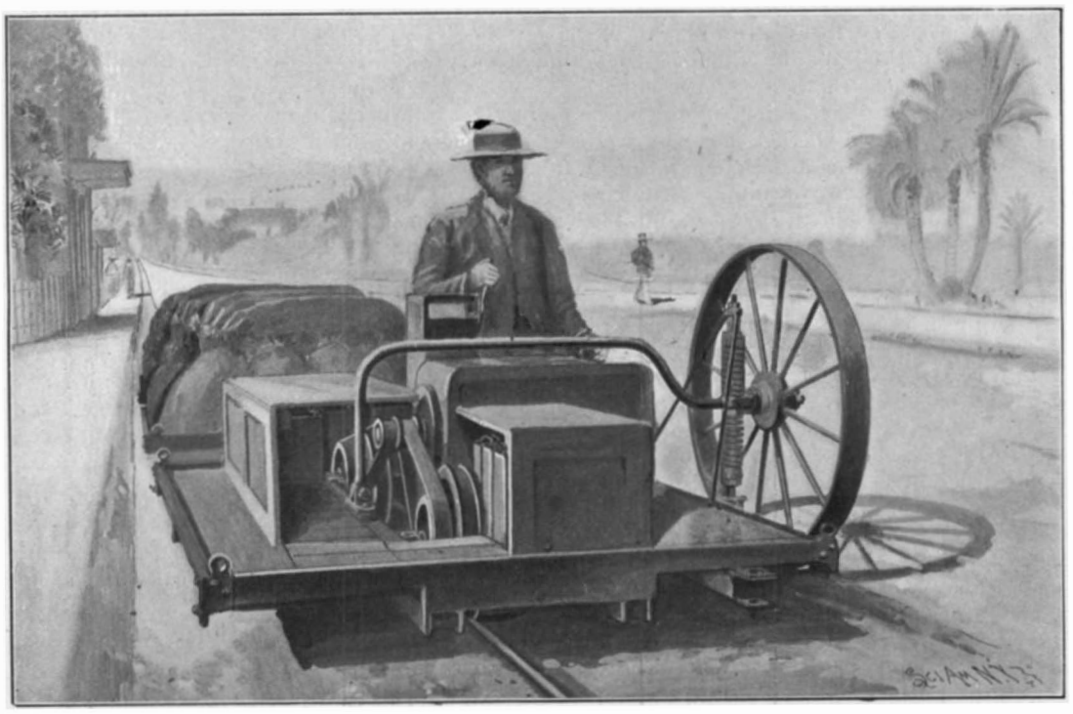
The Exposition authorities are making a special effort to finish the work of installing the exhibits, and the Minister of Commerce has issued a decree limiting the time allowed for this work. According to the decree, no installation work is permitted after May 12, and exhibits which are too late to be put in place will be refused admission to the grounds after that date, and the Administration will take possession of the empty spaces. No exception will be made to this rule except for special reasons admitted by the Commission. The same limit is made for the erection and installing of exhibits, and all building material, etc., must be removed from the grounds before May 13. The exhibits which are not finished on that date will be stopped by the authorities, who will take measures for removing the unfinished work.

A partial illumination of the grounds took place on Sunday evening, the 6th of May. The various buildings of the Champ de Mars had a line of incandescent lamps along the top, and the Eiffel Tower had a series of lamps from the base to the summit, outlining the general form. Some of the attractions were also brilliantly lighted up, but the Electrical Palace and Fountain could not be illuminated for the occasion, to the disappointment of the large crowd that had gathered in anticipation of this event. In the Champs Elysées section the grounds were brilliantly lighted up with a pleasing effect by a series of translucent orange colored globes containing incandescent lamps, these being hung in the trees all over the grounds, especially along the Seine, including a portion of the space occupied by the national pavilions. Some of these were also lighted up by rows of lamps outlining the main architectural features. The space between the Grand and Petit Palais was well lighted by arc lamps upon poles, and the Alexander III. Bridge by the bronze candelabra which are placed along the balustrade. These candelbra are very handsome, being in massive bronze of artistic design; each supports four large globes containing several incandescent lamps. On either end of the bridge is a large bronze group upholding a candelabrum of an elegant design; this is finished in antique bronze.

The Spanish pavilion was one of the first to be inaugurated, and the ceremony took place on the 8th of May. The pavilion is situated on the bank of the Seine, in the group of national buildings, between those of Germany and Monaco. Among those present at the ceremony were M. Picard, Commissioner General of the Exposition, Prince Roland Bonaparte and many other celebrities. One of the interesting features of the occasion was the presence of Mr. F. W. Peck, the United States Commissioner, with a number of the Exposition staff, thus showing the friendly relations which now prevail between the two countries. The American representatives were cordially welcomed by the Duke de Sesto, the Spanish Commissioner General and his staff. The building takes the form of a palace built in the style of the Spanish Renaissance. Its details are taken from different historic buildings. The façade is designed after that of the University of Alcala, constructed in 1553; another part of the building is copied from the Alcazar of Toledo, erected during the reign of Charles V. The University of Salamanca and various other palaces are represented. In the interior of the building is a large hall surrounded by arcades; a wide staircase leads up to the second floor, where the reception took place. The building is almost entirely occupied by a retrospective exhibition of the national art, and the Queen Regent has sent a number of interesting and valuable collections of ancient tapestry taken from the Royal Palace at Madrid.

SINGLE-RAIL STORAGE-BATTERY MOTOR.

The single-rail railroad has found an extensive field for usefulness in various parts of South America, and also pretty generally in India. In both countries the system is a form of the well-known Decauville system, in which the bulk of the weight is carried on two wheels alligned in the same longitudinal plane beneath the car, while the balancing is performed by a cross beam or outrigger, to which is harnessed the horse or mule which draws the load, or, if man power is used, the boom is steadied by an attendant. This is the plan which is more generally followed in South American countries. In India it is customary to place a wheel at the end of the outrigger and so distribute the weight in loading the car that the bulk of the load is carried by the rail wheels, only a small fraction of the weight being borne by the road wheels. These trucks are, as a rule, drawn by oxen. The truck, which is herewith illustrated, is being specially constructed for service in India; and, while it is built on the general lines of the ox-drawn vehicle, it differs from it in that the motive power is derived from storage batteries carried on the platform of the car. The motor is placed between the two wheels, and carries on its spindle a double pulley which is belted directly to a pulley on to each of the axles. The storage batteries are grouped around the motor and the whole is boxed over to form a carrying platform. The truck is designed to carry a load of a quarter of a ton, and is capable also of drawing two other trucks, each carrying a ton, at a speed of eight miles per hour. The single tracks for these railways are exceedingly economical to build, and if laid near the edge of the road, encroach but little upon the driveway. We are indebted to Mavor & Coulson, Glasgow, the builders of the truck, for illustration and particulars.



Capacity, 5,000 pounds of freight at eight miles an hour.

SINGLE-RAIL STORAGE-BATTERY MOTOR.

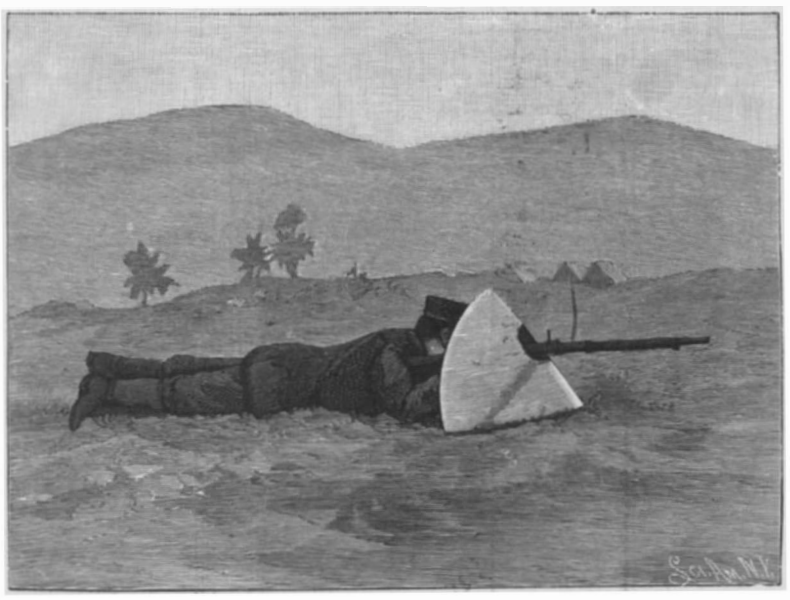
PORTABLE SHIELDS FOR INFANTRY.

A few years ago the question of equipping infantry with a cuirass to protest the most vital parts of the body against rifle fire was the subject of wide discussion. Several experiments were made with many so-called bullet-proof shields or breastplates, but in every case they were found to be penetrable at ranges at which it was desired to obtain full protection, and for the time the idea of providing infantry with armor was abandoned as impracticable.

The present struggle between the British and the Boer forces in South Africa has revived interest in the question, and several bullet-proof cuirasses or shields have been constructed and put to more or less severe tests; one or two of them with very gratifying results. When we bear in mind the high velocity and great penetrative power of the modern magazine bullet, the idea of providing infantry with a shield of reasonable impenetrability might seem to be chimerical, but if we recall the protection that has frequently been afforded by a pocketbook, bible or other object carried in the pocket of the soldier, the suggestion takes on a color of reasonableness. One of the most recent, and as tests have shown, the most practical efforts in this direction is the folding shield which forms the subject of the accompanying illustrations. It is formed in two separate parts, which are hinged together vertically, and when shut up can be carried on the back of the soldier without inconveniencing him, or hampering his movements on the march. One of the cuts shows the shield folded and strapped on the back, while the other two are front and side views which show the shield acting both as a rest for the rifle and a cover to the rifleman. The front view, in particular, suggests what excellent protection is afforded.

The shield, considering its protective power, is very light, weighing about 13 pounds and its shape when opened out and placed in position somewhat resembles the ram of a battleship. It has been proved to be impervious to Mauser and Lee-Metford rifles at a range of 700 yards, the bullet striking the sloping sides and glancing off. When painted the prevailing color of the surrounding country it is difficult to detect, since in form it bears a striking resemblance to a rock or bowlder. The man behind the shield, at least during the earlier stages of an advance in open order, can creep forward in comparative safety, and his invisibility is greatly assisted by the fact that he is using smokeless power.

While it is admitted that the device would be invaluable to sharpshooters and would greatly assist the work of "sniping," the main idea of the shield is to make it practicable to attack from the front in cases where flanking movements are impossible. The war in South Africa has brought home to the English and other nations the fact that, under ordinary conditions, the attack upon intrenched positions is a thing of the past. The game of war has been greatly modified by the introduction of the magazine rifle and the quick-firing gun, the attack being now placed at an enormous disadvantage, which is estimated by experts to range from five to one to as high as ten to one. The shield is expected to offset to a large extent the advantage of cover which is now enjoyed by the defense. The theory is that the storming party could work their way with comparative safety behind the shield to within say 400 yards of the enemy's trenches. At this range they would be able to concentrate a fire which would shake the morale of the enemy preparatory to the final charge with the bayonet.



SIDE VIEW, SHOWING SHIELD USED AS A RIFLE-REST.

IN MARCHING ORDER.

FRONT VIEW, SHOWING COMPLETE PROTECTION.

New Type of Battery.

Among the new types of batteries which have appeared in Europe may be mentioned that of Poppenberg, in which the positive electrode is a hollow cylinder or retort carbon filled with depolarizing matter and closed at the bottom of an insulating plate; the negative electrode is a cylinder of zinc. These two electrodes rest upon a false bottom consisting of a horizontal plate of porous material, constituting a diaphragm. Between the plate and the bottom of the cell is placed a thick layer of sulphate of soda, with or without the addition of common salt. When water is put into the cell, a portion of it traverses the porous diaphragm and dissolves the salt below, the solution then passing by endosmose to the water above. The strength of the electrolyte is thus rendered nearly constant. The battery keeps its strength for a long time and has an electromotive force of about two volts. The new accumulator invented by T. Michalowski utilizes the properties of sesquioxide of nickel; the positive plate is of nickel covered with a layer of sesquioxide, Ni 203, the negative electrode being a plate of zinc; an alkaline solution is used for the electrolyte. The characteristic point of this accumulator is the use of the sesquioxide of nickel as a depolarizer. Up to the present a number of cells have been devised using zinc, potash solution and metallic oxides, but the specific properties of the oxide of nickel have not as yet been taken into account, namely, that it is an endothermic body, giving off heat upon decomposition; owing to this property, the depolarizing action is considerable and the element keeps constant at a high voltage. The nickel plate is oxydized by heating it in air or oxygen, or with compound of oxygen and nitrogen under pressure.

Mounting Photographic Prints.

One of the greatest difficulties in mounting photographic prints is to prevent them from curving when dry; as this is due to the contraction of the print after having been distended by the water, a paste must be used containing as little water as possible. The following formula is recommended: Common gelatine, 2 parts; water, 4 parts; alcohol, 8 parts. The alcohol is added slowly as soon as the gelatine is well dissolved in the water, and the vessel turned continually to obtain a homogeneous mixture. The solution must be kept hot during the operation, and should be applied quickly, as it soon dries; the print must be placed exactly the first time, as it adheres at once. The solution keeps for a long time in well-corked bottles; when used it is heated on a waterbath.

SIR WILLIAM PREECE, the famous electrician of the General Post Office of Great Britain, gave an interesting lecture in London, on April 23 last, before the Institution of Civil Engineers, upon the latest developments of electricity, and Marconi's numerous experiments. Sir William Preece acknowledged that wireless telegraphy had made small progress, a circumstance which he attributed to the fact that there is no commercial business in the invention. The interest in wireless telegraphy does appear to have diminished in London, and Sir William Preece's poignant remarks will not give much further encouragement to those few who are so closely interested in Marconi's experiments. It may be remembered that Sir William Preece assisted Marconi when he first brought his primitive instruments to England.

WOOD MOSAIC.

Mosaic work in a variety of forms is always pleasing when well done. Although its origin is obscure, yet for centuries it has been one of the most favored mediums of decoration. In one of the southern counties of England there is still plied a quaint inlaid wood industry which is a modern example of this art. This inlaid woodwork, known as "Tonbridge ware"—a name suggestive of pottery—consists of views, flowers, borders, and so forth, in all their natural colors, with minute pieces of variously colored woods, each measuring about a twentieth of an inch square. So accurately are these pieces of wood cut, even at these minute dimensions, and so neatly and closely are they glued together, that they resemble one solid piece of wood with the design painted upon it. Curiously enough it was painted drawings upon white wood that originally suggested and subsequently evolved into the present craft.

The principal woods employed in the art are American birch, mahogany, fustic, walnut—American and Spanish—plum tree, tulip—with its beautiful fruit—red grain, cocus, snake wood, nutmeg, rosewood, mulberry, laburnum, box, peach, acacia, maple and Hungarian ash, with its charming silky luster and moiré grain. In short, no wood is useless for the craft so long as it does not contain too great a quantity of sap, although a remedy is found in the case of one or two necessary woods, such as the holly, which is boiled for several hours, an operation not only removing all the sap, but bleaching the wood considerably as well. There is one color, however, which has always puzzled the artist. Up to the present, no tree has been discovered the hue of whose wood is gray, and to supply this deficiency birds' eye maple and Hungarian ash are steeped for several weeks in the indigenous chalybeate waters, which convert the yellowish whiteness of these two woods into a soft steel-gray.

When it is proposed to inlay a certain view, border, or collocation of flowers in wood, a colored design is first of all prepared upon a piece of paper divided into squares of about the eighth of an inch in measurement. The design prepared, the workman proceeds to set it up in wood. This entails great labor and care, for in addition to being a skilled mechanic some artistic sense is absolutely essential in the judicious selection and composition of the different colored woods to obtain the necessary realistic effect. On all sides of him, within an arm's length, are ranged little piles of thin narrow slips of wood, each slip measuring about three and a half inches in length by about an inch broad, and varying from a twentieth to a twelfth of an inch in thickness. The workman begins at the bottom left hand corner of the squared design and takes the first set of squares and works across the drawing in a vertical direction. Suppose, for instance, he has to make a bouquet of flowers. He refers to the bottom left hand corner square of the pattern and finds that it forms part of the groundwork of the design; that is to say, no portion of the drawing encroaches upon that square. As the groundwork is invariably white, he selects a slip of white wood from one of the little piles and lays it flat down upon his bench. Then he proceeds to the next square above. This occupies a portion of the design—the end of a petal or a leaf. This is green, and he therefore selects a piece of wood of the correct greenish shade, and places this piece upon the former slip and proceeds to the next square above, and so on until he has worked his way right across the design, taking each square one by one and superposing their corresponding colored slips of wood, in their order of sequence in a little pile by his side. He then glues and presses these little slips tightly together in a little block, three and a half inches long, one inch wide, and two or three inches in thickness, composed of thin little strips of variegated wood. He labels this "number one" and proceeds to set up the second line of squares upon the drawing in a similar manner, which he afterward glues up and consecutively numbers; and so on until he has so constructed the whole design. If the drawing is a very large one, he may have as many as two hundred of these blocks of glued strips of wood. A thin veneer about the twentieth of an inch thick is now longitudinally cut from block number one. As he has now cut the reverse way of the wood, this veneer consists of a number of little frail sticks, three and a half inches in length and about a twentieth of an inch square, firmly held together by the glue. He lays this upon his bench, cuts a similar veneer from each of the other blocks, and glues them together in regular order. This block is now subjected to tremendous pressure to drive out all the superfluous glue and to unite the thin frail pieces of wood firmly together. In this block, the artist has obtained an exact and complete facsimile, square for square, of the drawing. When thoroughly dry, veneers are again longitudinally cut from this block, and each veneer is a replica of the pattern. Out of a block three and a half inches in thickness it is possible to obtain as many as thirty veneers.

Contains 32,600 pieces and over 100 different natural wood colors.

WOOD MOSAIC—THE PICTURE, WITH THE BLOCKS IN THE ROUGH STAGE.

Our illustration of a street conveys a comprehensive idea of the work at this stage. It appears to be an indistinguishable conglomeration of a number of small blocks of wood, and presents a blurred and fuzzy appearance, like a photograph very much out of focus. This particular design only measures six inches by four and a half, yet there are no less than 32,600 pieces of wood, extending over one hundred different colors, utilized in its composition.

THE ASSAYING OF GOLD AND SILVER ORES.

BY WILLIAM B. GAMBLE.

The assayer's first operation consists of a thorough sampling of the ore. The reason is plain. Metal-bearing rocks are not at all homogeneous. Barren quartz is often found next to mineral assaying thousands of dollars to the ton. The amount to be assayed must be made to represent as accurately as possible the average of the whole lot.

The ore is first sampled as it comes from the mine, and later at the smelter, chlorination works, or cyanide plant, as the case may be. When mechanical samplers are not employed, the general practice is to throw aside every fifth shovelful into a conical pile, which is afterward divided vertically into four equal parts—or "quartered" as the operators say. Opposite segments are withdrawn and thoroughly mixed together. This operation is repeated until the sample is of a convenient size, when it must be passed through a small hand crusher. The latter should be thoroughly clean—a safeguard against error, which is possible when rich ore has been previously crushed. The writer knows of several cases in which the ore from a worthless prospect has assayed like that from a dividend-paying mine—a result due to carelessness in this particular.

In many cases the sample is still too large when it comes from the crusher, and it must be further reduced until it can be conveniently handled on the apparatus about to be described. The latter consists of an iron plate two feet square and provided with flanges at the two sides in order that the ore may not be brushed aside. This device is known as the bucking-board. Its complement, called the muller, is a piece of cast iron resembling an ordinary cigar box in size and form. This is manipulated by a long handle parallel to the upper surface. The lower surface is convex, so that a rocking motion may be imparted to the whole.

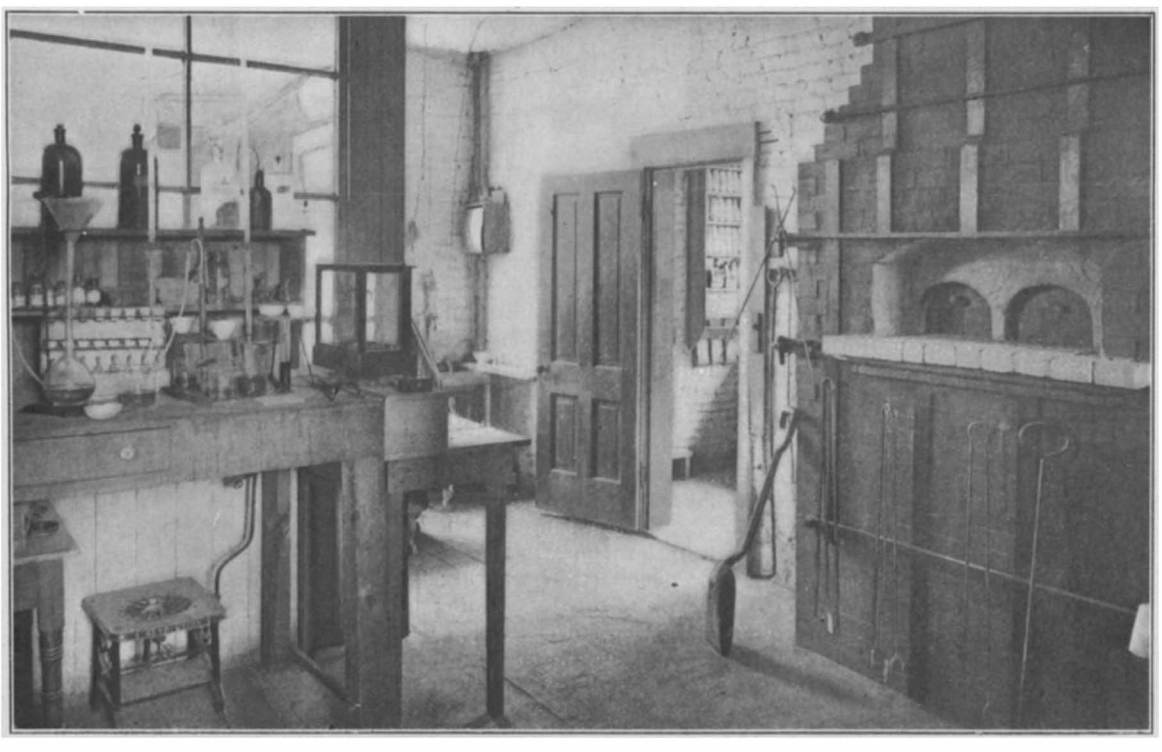
The bucking-board having been cleaned and the sample spread over its surface, the operator, with a backward and forward motion of the muller, grinds the ore to a pulp sufficiently fine to pass through an eighty-mesh screen. When this operation is completed the screen should be examined for any particles of free gold which may have clung to the wires. If any are found they must be weighed and their total value computed in relation to the weight of the whole pulp sample. The value to the ton is very easily calculated—which figure must be included in the final assay result.

After the pulp has been rendered homogeneous by rolling it in a small piece of oilcloth it is spread into a thin layer, from which small portions are taken until an amount known as half of an assay ton is obtained.

Here it is necessary to explain the system of assay weights. As I have before mentioned, gold and silver ores are valued by the amounts of these metals contained in the ton of rock. These amounts are generally expressed in ounces troy. Of course, any system of weights might be used and the final result calculated in ounces to the ton. But the assayer is a busy man who shortens his labors whenever he may do so without a sacrifice of accuracy.

This is a convenient place briefly to mention the scales used in assaying. There are generally two: those for weighing the pulp sample, and the "button scales" for weighing the metals obtained. The latter, which are provided with a rider, or hook, adjustable along the beam, weigh correctly to the one one-hundredth part of a milligramme, or less than two ten thousandths of a grain.

Now the problem in establishing a system of assay weights is to read milligrammes and fractions thereof as so many ounces to the ton directly from the button scales. The matter, of course, is simply one of proportion; it being necessary to weigh out an amount on the pulp scales which shall bear the same relation to a milligramme as a ton does to an ounce. We know that there are 29,166·66 ounces troy in the ton of two thousand pounds. Therefore 29,166 milligrammes is the pro-



THE ASSAYING OF GOLD AND SILVER ORES.

per weight to represent a ton. This is known as the assay ton. As the bulk of this weight of pulp is a trifle large for the ordinary crucible; only one-half of the amount is usually taken, and the gold and silver results multiplied by two. For example: suppose that we have a reading of 2·2 milligrammes for gold and 60·2 milligrammes for silver. These figures signify 4·4 ounces of gold and 120·4 ounces of silver to the ton.

To return to the preparation of the assay. The one-half assay ton of pulp is placed in a small fire-clay crucible, care being taken that the latter is perfectly clean. If the determination is for gold alone and the assayer suspects that the ore carries little or no silver, a small piece of the latter metal (which should be chemically pure) is added to the pulp. This is done for the reason that gold and silver are thrown down together and that the gold, which often appears as a mere speck, might otherwise be difficult to find, or in greater probability lost.

In the succeeding operation the assayer's knowledge of chemistry comes into play. I refer to the fluxing of the charge; that is, the addition of materials which will remove the non-essential ingredients of the ore. Among the various fluxes in common use are the following: Sodium and potassium carbonates, which are used for the decomposition of silicates; lead oxide, otherwise known as litharge, which not only supplies the lead for the mechanical carrying down of the gold and the silver, but which acts as a powerful oxidizing and desulphurizing agent; flour and argol, which, by means of their carbon, act as reducers—that is, they take oxygen from other parts of the ore; niter, which freely supplies oxygen; and, lastly, iron, generally in the form of nails, which acts as a desulphurizing agent. Borax is a most important factor in most assays, both on account of its strong acid reaction and its use in preventing too vigorous a boiling of the crucible's contents. Salt is very often substituted for the latter purpose.

The fluxes, which have been mixed in the proper proportions, are intimately mixed with the pulp. The charge, having been covered either with a layer of borax or salt, the crucible is introduced into the white hot muffle of a reverberatory furnace. It is at this point that many an inexperienced operator fails. Success is due to his ability to keep his furnace at a high uniform heat. If he is unattentive in this respect, he might as well abandon his task at once. A view of a typical furnace, with asbestos doors to prevent the escape of heat from the muffles, is shown in the photograph. Coal is fed into the furnace from the rear.

When all sounds of boiling of the crucible contents have ceased—that is, in about forty-five minutes, if the fire has been favorable—the glowing charge is removed and carefully poured into a mold. The lead (supplied either from the litharge or from the ore itself) sinks to the bottom and carries with it the gold and silver. When the whole has cooled, the slag is broken off and the lump of gold and silver bearing lead pounded with a hammer into a convenient cubical form.

The separation of the precious metals from the lead is the next problem. The procedure is based upon the fact that lead oxides at a temperature not sufficiently great to cause serious losses from the gold and silver by volatilization.

The lead cube just mentioned is placed in a small bone-ash dish called a cupel, which has already been heated in the muffle. The heat should be carefully watched during the process of cupellation. Until the lead is melted, the muffle door should be closed. It is then opened; not only that the temperature may be reduced to the proper degree, but that a current of air, for the purpose of oxidizing the lead, may pass over the cupel and out of a small aperture at the back into the chimney. Thus a portion of the lead is oxidized and carried off as fumes, while the remainder is absorbed by the bone-ash of the cupel.

As the last of the lead disappears, the mass of gold and silver which remains suddenly solidifies and becomes dull, or "blicks"—an action which warns the operator that it is nearly time to remove the cupel from the muffle.

If no silver has been added to the original charge, and it is desirable to obtain the silver result, the button of associated gold and silver, which we will call bullion, is weighed on the button scales. The amount (multiplied by two, as before explained) read off in milligrammes represents the number of ounces of bullion to the ton.

The determination of the gold value is the next step. The bullion button is transferred to a small porcelain dish and covered with dilute nitric acid. It is then gently heated. If the amount of gold is not excessive it takes but a few moments for the silver to dissolve. The residue of nitric acid and nitrate of silver (in solution) is then decanted off, leaving a black spongy mass of gold. After the latter is dried and annealed to its yellow color in the muffle, it is carefully weighed. This amount is substracted from the bullion weight, the difference representing the silver value.

While to some assayers the crucible method is quite satisfactory, others claim that it fails to recover the full amount of silver. In many localities, notably in Colorado, where a close saving of this metal is desired, what is known as the scorification assay generally accompanies the former.

The scorifier is a shallow fire-clay dish, circular in form and about two inches in diameter. In this is usually placed one-tenth of an assay ton of pulp which should be mixed with about twenty grammes of chemically pure test lead. A like amount of the latter is then spread over the mixture and a small quantity of course grained borax added. The charge is placed in the muffle and the asbestos door is closed until the operation is well under way. It is then noticed that the melted metals lie in the center of the scorifier as a glowing mass surrounded by a ring of melted slag. When the latter has completely closed over the metals the assay is poured into a mold. The slag is removed, and as before described, the lead button is cupelled. If the ore is known to run very low in gold the bullion weight is accepted for that of the silver, because the almost inappreciable amount of gold in one-tenth of an assay ton in such a case would scarcely warrant a separation of the two metals. A silver result, correct to one-half an ounce to the ton, is generally regarded as sufficiently close.

It cannot be emphasized too strongly that every step in the operations above described must be taken with the greatest care. If there is an exact art, that of the assayer certainly lays claim to the distinction. The possibilities of error are many and only careful men may hope to retain their business or their positions.

COTTON TRADE SCHOOLS IN THE SOUTH.

BY J. A. STEWART.

The progress which the South has been making in cotton manufacturing augurs well for the future prosperity and advancement of the Southern section. While there were 7,160,000 cotton spindles in Massachusetts at the beginning of 1895, there was no State south of Mason and Dixon's line with a million. Now there are two, North and South Carolina, with over that number, thus exceeding all the New England States excepting Massachusetts, Rhode Island and New Hampshire.

The value of the cotton goods manufactured in the eight Southern States in 1880 was $16,173,222, and in 1890 the returns showed a value of cotton manufactures reaching $40,165,074 or a gain of nearly 250 per cent.

This splendid growth is bringing the South into prominence through the enhancement thus given to national American industries. Its progress is also bringing it into closer relation and a clearer understanding of the development of the manufacturing interests which comprise so large a portion of the life and prosperity of the nation. Furthermore, this grasp of conditions is shown by the growing realization in the South of the need of trained craftsmen and educated workmen to conduct its colossal manufacturing interests.

Like textile manufacturers in foreign countries, manufacturers in the South are recognizing that the system of training workmen in the mill is ineffective, for the textile mill is an establishment whose chief purpose is production and not instruction. Consequently they have been awake to the necessity of establishing textile schools, from which are to come trained workmen and educated engineers for the carrying on of their large and growing textile industrial enterprises.

The first cotton trade school in the South is that started in 1898–1899 in connection with the Georgia School of Technology at Atlanta, Lyman Hall, president. Clemson College, S. C., has also recently opened a textile department in a building especially erected for its use under the direction of J. H. M. Beatty. By the establishment of these two trade teaching institutions, the South has justified its claim to textile educational enterprise.

The Atlanta institution is very complete. It was designed by a Boston architect, and as it stands it embodies the very latest ideas of mill construction, as well as a convenient school department.

The school is the outcome of the legislative act of December, 1897, which appropriated $10,000 for the establishment of the Textile School on condition that its friends contribute $10,000 additional in money and machinery. A wealthy philantropist. Mr. Aaron French, of Pittsburg, became the chief benefactor of the institution. In his honor it has been named "The A. French Textile School." In December, 1898, the legislature appropriated $10,000 for two consecutive years for the support of the school. The building is of brick, 150 by 70 feet and three stories in height. The basement floor contains the laboratory, dye house, receiving and finishing rooms, store and washrooms, the engine room, a ginery and a lecture room. On the first floor one finds the department devoted to preparing the warps and weaving. Here are also the designing room, a room for Jacquard designing, an exhibition department besides the principal's office. The top floor is occupied by the carding and spinning department, where the cotton is brought from its crude state up to a finished yarn ready for weaving.

The equipment of the school is complete. In appreciation of the advantage of having the future mill men of the South familiar with their machinery, the machine manufacturers have donated whatever was required by way of equipment to a valuation of $20,000. The shafting makers, the belting company, the automatic sprinkling company, the ventilating and heating company followed in line, as did the makers of the Drosophore humidifiers—machines very essential to the cotton manufacturing industry in the hot, dry South, where natural atmospheric conditions would otherwise be too unfavorable. Every machine of consequence known to the cotton manufacturing industry is to be found here, and in most cases in considerable variety of makes of manufacture.

The student who has mastered the technicalities of the plant in a school of this sort will have no trouble in manipulating or caring for any machine he may find in any up-to-date mill in actual business. There are four types of cards; a Winship 60 saw cotton gin, gin feeder and condenser; two kinds of drawing frames, a railway head, a ribbon lapper, a comber, five processes of fly frames, three types of ring spinning frames, four spoolers, three winders, and a wet and dry twister. The student learns the process of weaving on about fifteen different kinds of looms, from those making heavy coarse cloth to the finest Jacquard products. Among these looms are Whitin, Mason, Crompton & Knowles, Kilburn, Lincoln, Northrop, Calvin and Jacquard looms.

The curriculum of the school is as broad as its equipment is complete. There are courses in mathematics, English, drawing, mechanics, textile design, chemistry and dyeing, millwork and shopwork to be studied in four years. Special courses of two years in designing and weaving, carding and spinning, chemistry and dyeing are provided. Thus the needs of most of the branches of the textile industry in the South are met. The special feature of the textile course in the Georgia school are the courses given in the different shops synchronously with the work in the cotton mill. Special prominence is given to the elements of practice of every department. Although this is the first year of practical operation of this department one hundred and twenty-five young men have matriculated.

Clemson College Textile School, also inaugurated last fall, provides a similar four year course in which the textile instruction is incorporated in the regular college work, the increasing development of cotton manufacturing in South Carolina having brought about a demand for more complete textile training. At Clemson the purpose is to expand into a broader curriculum of textile industrial art, to include the manufacture of wool, silk and linen products. The textile building at Clemson is a two-story brick structure of modern cotton mill design, lighted by electricity, heated by steam and protected from fire by automatic sprinklers. On the first floor are the recitation rooms, the carding and spinning departments and the office. The dyeing and weaving departments are on the second floor. The equipment is fully as comprehensive as that of the Georgia institution.

It is well held that three years spent wisely in a school are equal to twice that time in a mill. These two schools may be looked on as pioneers in a group that will cover the whole cotton growing requirements of the South; to which learner and manufacturer can turn alike for information and for assistance, and from which trained experts will graduate, whose knowledge and skill will be devoted to the further development of the great textile industry.

Without a doubt, the expansion of textile education in the South will be coincident and contributory to the new era of southern industrial progress. The time has come when the manufacture of those textiles which are now imported from abroad to an extent exceeding one hundred million dollars' worth annually will be conducted in this country; and when the South's vast product of cotton will no longer be chiefly shipped in the bale to be manufactured into cloth in foreign mills, but will be wrought into fabrics in this country, thus giving industrial impetus to a large section greatly in need of it.

ON May 12 ended the British tour of the Automobile Club. All the cars which went through the trial traveled a minimum of 1,059 miles, and some of them made a distance of 1,107 miles. There were eleven actual running days since the competing vehicles left London, the balance being made up of Sundays and one-day exhibitions. The longest day's journey was the last, the trip up to London being made from Nottingham, a distance of 123½ miles. The shortest day's trip was the run between Kendal and Carlisle, a distance of 61½ miles. It is impossible to state at present, until the official figures are published, how many cars went through the trial from the start to the finish.

IN the harvest of 1899 there were 1,265,601,664 gallons of wine produced in France; 766,107,500 gallons produced in Italy; 594,393,750 gallons produced in Spain, and 158,505,600 produced in Roumania. The total production of the old world is estimated at 3,338,101,704.

Science Notes.

Three hundred and twenty acres of land have been purchased in Salt River Valley, the idea being to consolidate, as far as possible, the ostrich industry.

A swimmer who broke his neck last August, and who was successfully operated upon, is now able to write and his hand gained steadiness with each attempt.

The statue of the late Prof. Huxley by Onslow Ford was recently unveiled. It has been placed in the great hall of the Natural History Museum at South Kensington.

A crystal of beryl has been found at Grafton, N. H., which was 2,900 pounds and another from the same locality measuring 45 by 24 inches weighed by calculation about 2½ tons. In Utah crystals of gypsum over 4 feet long have been found. A crystal of spodumene—lithium, aluminium silicate—30 feet long has been discovered in South Dakota.

The question of the stability of the Ducal Palace in Venice is receiving great attention. The alarming reports which are being published are apparently exaggerations. The great library and archæological museum are to be transferred, thus relieving the weight of the upper stories. The palace was never intended by its builders as a storehouse for books and heavy models.

Vesuvius is becoming more and more active and those who live around it are greatly alarmed. Experts are inclined to consider that there is no immediate danger. The station of the cable road which leads to its summit has been destroyed. Four English travelers, who were making the ascent of the volcano ventured too far and were overtaken by the lava and seriously burned.

An aeronaut was recently poisoned by hydrogen arseniide, which escaped from the balloon. This shows the necessity of purifying the hydrogen used for balloon purposes. The balloon was filled in the ordinary way and nothing peculiar in the odor of the gas was noticed. A few hours afterward the persons who had assisted in the operation were taken seriously ill and one of them died.

A field station in connection with the New York State Museum is to be opened during the summer on Saranac Lake for the study of the biology of aquatic insects. This is believed to be the first station in the United States where fresh water insects will be under investigation. Charles Needham, professor of biology at Lake Forest University, has been selected by the management of the New York State Museum to conduct the work.

In the year 1898–99 the medical faculty of the Paris University graduated 671 doctors, of which 79 were foreigners, besides 13 health officers, 48 midwives and 68 dentists. The number of medical students enrolled is 4,412; of this number 570 are foreigners. The Russians number 180; the Roumanians 79; Germans, 26; Greeks, 25; Swiss, 21; South Americans, 12. There are 129 women students, 100 of which are foreigners, including 91 Russians, 5 Roumanians, 2 Greeks, 2 Swedes and 1 English student.

It is probable that the metric system will be introduced before long in Russia; the bill which has been prepared to this effect by the Minister of Finance has received the approbation of the State Council, with the understanding that the University and the various scientific societies will give their assistance in the verification of the weights and measures necessary for commercial use. The details have been nearly all decided upon, and will be submitted to the Council in the near future. Since 1896 the metric system has been used by the medical service of the army in the compounding of formulas, this having been made obligatory.

On December 27, 1896, there occurred over Melbourne and a considerable area of Victoria an unusually heavy fall of dust of a red color which was carried down by an accompanying rain. Mr. T. Steel examined a sample of the dust after drying it at a temperature of 110° C., and obtained the following results: Organic matter (nitrogen 0·30), etc. (loss on ignition), 10·70; sand, insoluble and undetermined, 66·23; soluble silica, 0·75; ferric oxide, 4·68; ferrous oxide, 0·50; alumina, 15·16; lime, 1·36; and sulphuric anhydride, 0·62 per cent. It is stated that the dust agrees very closely in appearance and composition with volcanic soils from Northern Queensland, New South Wales, and Fiji Islands.

Dr. Chavernac, of Aix (France), has just designed a new army stretcher. It is a rigid contrivance made in two halves, and its advantage over the existing French ambulance is that the wounded man can be lifted off the ground without experiencing any shock or pain. The halves of the stretcher are placed on each side of the sufferer and by pressure they fold together under the body of the patient, who is not touched with hands at all in the operation. When loaded the strecher is mounted on a light bicycle carriage. Under the existing conditions of ambulance work in France, four men are required to lift the wounded man, but by the aid of the new stretcher only two attendants are required.

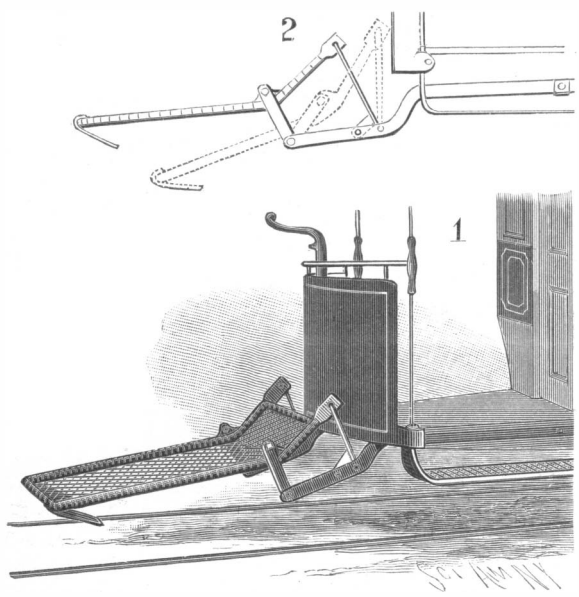
The Paris-Roubaix Races.

The Paris-Roubaix races showed a very high speed obtained by the motocycles; one of the concurrents, Barras, made an average speed over 262 kilometers of road of 69 kilometers per hour, and in some places reached a speed of nearly 100 kilometers. From Beauvais to Breteuil the distance is 29½ kilometers, and the time required to cover the distance was 18 minutes, giving an exact figure of 98 kilometers per hour. The race was marked by an unfortunate accident, which has caused a great deal of comment, and may result in legal restrictions or even suppression of automobile races. A large crowd of spectators was assembled at a point where two roads crossed, the motocycles being obliged to make the turn here. In front of the crowd was a row of bicycles. The two motorcycles arrived, and one of the runners made a turn which was somewhat too large, and the other, who was going at a greater speed, tried to make the turn on the inside; the two tricycles became entangled, and ran into the crowd of spectators, who were partially protected by the row of bicycles. Two persons were seriously wounded, one of whom was the wife of a deputy. Some of the French journals made this the occasion to decry automobile races in general, and there is talk of restrictive legislation or prohibition of automobile races in the future.

A NEW FORM OF CAR-FENDER.

To provide a fender for street-cars, so arranged that, normally, it will be held in raised position, and that, upon striking an obstacle, it will be immediately depressed, is the purpose of an invention controlled by the Rodman Car-Fender Company (Mr. Fred S. Pickering, secretary), of Olathe, Kans.

Fig. 1 represents the platform of a car provided with the fender. Fig. 2 is a side elevation of the fender.



THE SAUNDERS-RODMAN FENDER.

The fender consists of a netting stretched on a stout tubular frame, carried by two pairs of links pivoted on supporting-bars attached to the car. One pair of links is pivoted to the forward ends of the supporting-bars and to the side tubes of the fender-frame; the other pair of links pivotally connects the rear portion of the fender-frame with the supporting-bars.

In the normal position of the fender, the links will all be inclined upward and forward, as shown in Fig. 1, and will be thus supported by means of stops engaging the rear links. When the front of the fender comes in contact with a person on the track, it will be forced rearwardly and downwardly, as shown by dotted lines in Fig. 2, so that the shoes on the front portion will engage the track-bed, and the person will be picked up or thrown to one side out of danger. The merits of the device are so obvious that extended comment is unnecessary.

A NEW form of ozonizer has been devised which consists of two long concentric square conduits of thin wood; the space between them is filled with a kind of metallic matting composed of a central web of wire-gage in which are placed vertically a great number of small wires. In the central conduit is placed a kind of continuous wire brush, obtained by fixing to a central core a series of wires which project out radially, their point facing the points of the wire matting in the outer conduit. The two are concerted to the poles of a high tension electrical machine and a current of air is passed into the conduit, which at one end opens into a box containing the aspirator. The other end is connected with a chamber through which enters the air to be ozonized; it contains a layer of cotton to intercept the dust particles. The use of metallic conductors of this form has the advantage of providing a great surface of action and at the same time they are sufficiently elastic to take up the expansion and contraction due to the heat disengaged. In practice a number of these conduits are placed together to increase the output.

Engineering Notes.

A château near Prague has been lighted by 1,200 jets of acetylene gas.

Mr. Charles P. Haughian, who died recently, was the founder of the chrome steel industry in the United States.

The total number of compound locomotives built in the locomotive works of America is 1896 up to date. Of this number, 1329 were constructed at the Baldwin Works.

Pullman palace cars are to be used on the Yukon and White Pass Railway from Skagway to Lake Bennett. They are only 40 feet long and weigh 15 tons. The railway company is building 200 freight cars.

The Coolgardie, Australia, water pipe line is a hydraulic enterprise of the first magnitude. It involves the construction and placing of 328 miles of 30-inch steel pipe which will deliver daily 5,000,000 gallons of water.

There has been a marked improvement in the state of trade in Palestine since the opening up of the country by the Jaffa-Jerusalem Railway. The transportation of goods from the coast to the interior is now rendered very easy.

A new kind of map for railway stations is being introduced in England by the Northeastern Railway Company. The map is made up of white tiles and is about 6 feet square and each tile is 8 inches square. The lines are marked in black and burnt Sienna.

The paved streets of New York aggregate 1720 miles of which Brooklyn provides 548 miles and Manhattan 405 miles. There are 745 miles of macadam streets; 339 miles of granite, 238 miles of cobblestones, 230 miles of asphalt, 84 miles of trap, 45 miles of Belgian block, 19 miles of brick; 13 miles of gravel and 0·08 miles of wood pavement.

A ladle full of molten iron was overturned recently on a trestle at the works of the Illinois Steel Company, at Chicago. The cars hold about 10 tons of metal and are operated by electricity on an elevated track, beneath which a number of men were working at the time of the accident; eight of the men were badly burned by the flying metal.

In the German army movable targets are used. The targets are drawn forward by the aid of ropes and pulleys, and the targets rest on small skids. As the trucks move forward the infantry, kneeling down, fires at them. This gives them a practice which enables them to familiarize themselves with the best methods of repelling a cavalry attack.

Arrangements have been perfected by which Russian oil will be distributed in Germany. In the last few years American petroleum has practically monopolized the German market. The German government has now offered facilities to Russian producers in the way of reduction of railway rates, so that it is expected in the near future, the Russian oil trade will make considerable progress in Germany.

An ocean depth of 5,260 fathoms, or 31,560 feet has been found by the United States steamer "Nero," which has lately been engaged in making soundings for a submarine cable between Guam and Manila. In November, 1899, the "Nero" reported a sounding of 4,900 fathoms about 500 miles east of Guam. The deepest ocean sounding heretofore reported was 30,930 feet, northeast of New Zealand and east of the Kermadecs, in the South Pacific.

Experiments are being made in Germany with beech as a material for railway sleepers. It has been found that without preservative treatment such sleepers are apt to rot internally though they may be apparently sound on the exterior. On the Alsace-Lorraine lines, favorable results have been obtained with creosoted beech sleepers, which have shown an average life of 19½ years, while others preserved with zinc chloride have proved still more satisfactory, their life being 21½ years.

The oil engine is growing in favor in Palestine, says The Engineer. The engines are used for drawing water from deep wells and for irrigating the orange gardens where they are extensive and a constant supply of water is necessary. Hitherto there has been employed from six to eight mules for turning water wheels which involve considerable expense. It is found that an oil engine of 6 horse-power, or even less, will raise double the quantity of water in the same time that a horse or mule will, while the expense is about the same.

Recently in making repairs upon the interior of a dwelling house in Boston, the discovery was made that the water pipes were lined with glass. The house was built some sixty years ago, and when Cochituate water was introduced into Boston, the owner of the house with hundreds of others became panic-stricken over the possiblity of lead poisoning and had all of the pipes used in bringing city water into his house lined with glass. This was expensive and unsatisfactory, and few attempted to have the glass-lined pipes. It is thought that no other house in Boston has plumbing of this unique nature.

THE PARIS EXPOSITION.

When the Exposition of 1889 closed, it was suggested that the end of the nineteenth century be fittingly commemorated by another great world's fair upon the banks of the Seine. The idea was taken up enthusiastically, and great specialists in the creation of world's fairs have since been devoting their entire attention to the formulation of plans for the largest and most interesting Exposition which the world has ever seen. Now the plan has materialized, and Paris, for the eleventh time, is welcoming all the world to the splendid showing upon the banks of the Seine. If the French do not understand the art of exhibition making, certainly no other nation can lay claim to it, for the first exposition that was ever held was on the Champ de Mars under the Directory, in 1798; and successful exhibitions were held in Paris in 1801, 1806, 1834, 1844, 1849, 1855, 1867, 1878 and 1889. The situation of Paris as regards such gatherings is unfortunate, owing to the fact that the space at her disposal in the center of the city is very limited. This difficulty has been surmounted, however, by a most judicious distribution of the structures and by the utilization of the banks of the Seine. In reality there are six sections of the Exposition, covering an area of 470 acres. The first section abuts on the Place de la Concorde, and it is connected with the Invalides section by the Alexander III. Bridge. The Champ de Mars and the Trocadero section are located at some little distance, and are connected on both sides of the Seine by a continual line of buildings which border its banks. There is also an important annex in the Bois de Vincennes, several miles away, where machinery, transportation exhibits, etc., can be installed and suitably displayed, as well as affording facilities for sports of various kinds. The concessions or "Midway" features, as we might term them, are scattered all over the Exposition, some of them being in the grounds, and some out of them but connected with them.

Although the Exposition was opened on the 14th of April, the grounds and buildings were in a state of great confusion, and those who intend to visit Paris have done well to delay their journey for several weeks after the opening day, thereby saving themselves miles of travel through empty and cheerless exhibition halls. It is said that no less than 6,000 men have been working at one time upon the Exposition. There are 30,000 French exhibitors, 6,564 American exhibitors; then follows Belgium with 2,500, Germany with 2,000, Italy with 2,000, Russia with 1,500, Scandinavia with 1,400, Austria 1,000, and Great Britain 600, and the British colonies with 600 exhibitors. The total aggregate of the exhibits and concessions is enormous, and in point of size the present Exposition excels even our own World's Fair of 1893.

From the Champs Elysées the visitor passes through the monumental entrance, which has been termed "the great money box" by the irreverent, and arrives at the two buildings devoted to fine arts, the smaller being given up to a retrospective exhibition of French art and the larger to exhibits of the contemporaneous art of the world. The new Avenue Nicholas II. separates the two buildings and leads directly to the Pont Alexandre III., which crosses the Seine, forming a continuation of the avenue and connecting the two sections of the Exposition. The Esplanade des Invalides is a very handsome avenue, bounded as it is on both sides with important groups of buildings which have a remarkable unity. The avenue is terminated by the dome of Napoleon's tomb. The arrangement of the buildings is somewhat peculiar; thus if the exhibits of French furniture are to be visited, it is necessary to go to the building on the left side of the Esplanade, but if visitors desire to look at foreign furniture exhibits, they must cross the avenue to a building directly opposite. The buildings on the Esplanade are devoted to national manufactures, the decoration of the furniture, and diverse industries. Leaving the Esplanade and continuing down the left bank of the Seine, the "Street of Nations" is reached; here are pavilions which are the official headquarters of the various governments which participate in the Exposition. This valuable feature was lacking in the Exposition of 1889 and was probably the most popular thing of the Exposition of 1878. These pavilions are devoted to some extent to the exhibition of the products of the country for which it stands, but some of them are reserved exclusively for reception purposes or for artistic or historical collections. One of our engravings represents several

THE "STREET OF NATIONS" ON THE LEFT BANK OF THE SEINE.

VIEW OF THE ESPLANADE DES INVALIDES LOOKING ACROSS THE ALEXANDER III. BRIDGE.

of these pavilions on the "Street of Nations" looking toward the Alexander III. Bridge. The first one is the palace of Austria-Hungary, which is a baroque construction. The United States building, of which Mr. W. A. Coolidge was the architect, and M. Morin Goustiaux the French collaborator, is a large and imposing structure, measuring 85 × 90 feet, and is 165 feet high from the lowest level. In a general way the building suggests without imitating the capitol at Washington and the Administration building at the World's Fair. The architect has done his best to make the building prominent, and his efforts have been successful, for none of the other buildings have such high domes, and the main entrance, which is under a large portico, also makes it very conspicuous, as it covers the thoroughfare along which visitors must pass. In front of the building is a boat-landing, which is ornamented so as to resemble a classic trireme.

The pavilion of Turkey, which is next, resembles the palaces which can be found along the shores of the Bosphorus. Its architecture is frankly Oriental, being a happy mixture of the most interesting types to be found in Constantinople; on the lower level is a Turkish café.

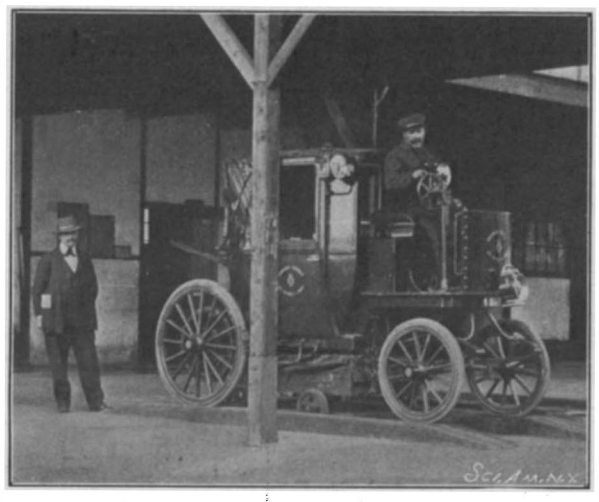
The pavilion of Italy is one of the finest buildings in the entire Exposition, and by reason of its dimensions is the most important of all on the "Street of Nations." Its architect has succeeded in masking the effects of the material employed. It is in somewhat florid Byzantine style, and resembles, to a certain extent, San Marco at Venice. Mosaics and marbles are freely used, and there are five great domes of bronze gilded.

ELECTRIC CAB SYSTEM OF PARIS.

The city of Paris is provided with an electric cab service which, although at first in a more or less experimental stage, is now rapidly coming into successful operation. The Compagnie Generale des Voitures, which operates all the cabs in the city, some time ago made an addition to its existing property just outside the city limits, and has erected a number of buildings to accommodate the electric system, including a power house, accumulator building, carriage-house, etc.

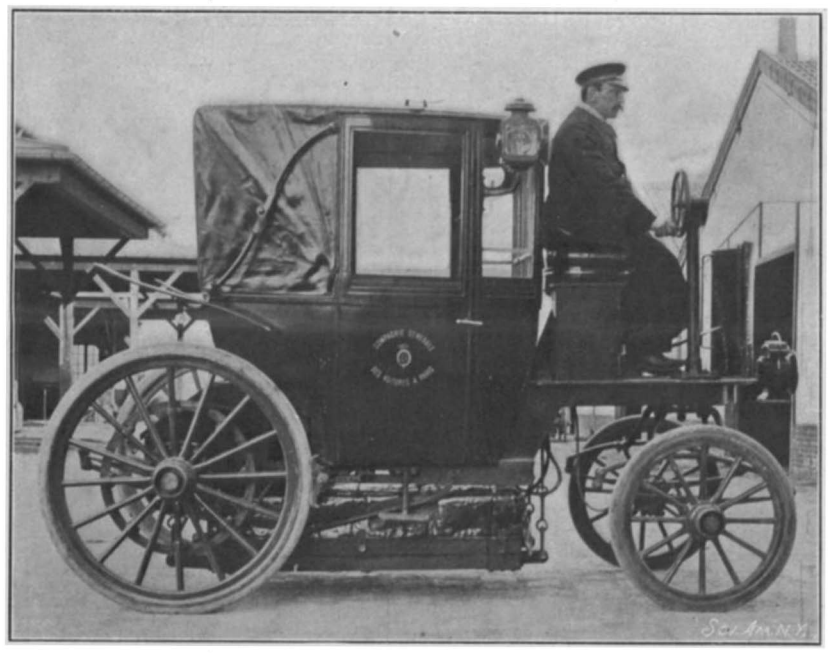
After a number of tests, the company decided to adopt the type of cab shown in our engravings. The cab body, which is interchangeable, is supported on a frame which rests upon the front axle by two elliptical springs and upon the rear axle by two springs placed longitudinally, this disposition being adopted to give more room to the motor and differential. The case containing the battery is supported underneath the frame of the vehicle, this arrangement permitting of an easy replacement. The motor drives the rear wheels by means of chain gearing, the wheels being of wood with solid rubber tires. To steer the vehicle the forward truck is turned by means of a hand-wheel in front of the motorman's seat. To the springs of the cab are attached four wrought iron arms supporting a bronze crown upon which turns a similar crown attached to the frame; a series of rollers is provided to diminish the friction between the two crowns, the lower one carries a central pin upon which it turns; this crown is toothed around its periphery and engages with a pinion on the lower end of the vertical steering shaft. This shaft passes up through an iron column shown in the front of the cab, where it ends in a pinion, this being turned by an endless screw worked by the hand-wheel; in this way the motorman steers the vehicle.

The lower engraving shows the general arrangement of the motor and back part of the cab. The motor is of the Lundell-Johnson type; it has four poles and is series wound. It differs from the usual type of motor



CAB ON RAISED TRACKS; TROLLEY WITH FRESH ACCUMULATOR BENEATH.

in having two commutators, one on either end of the armature, this latter having two series of windings. The field coils are also divided into two separate circuits, thus permitting several different combinations of circuits to regulate the speed without changing the battery connections. The weight of the motor is about 96 kilogrammes and it gives from 3½ to 4 horse power, with a speed of 1,500 revolutions per minute, when the cab runs normally at 16 kilometers per hour. The



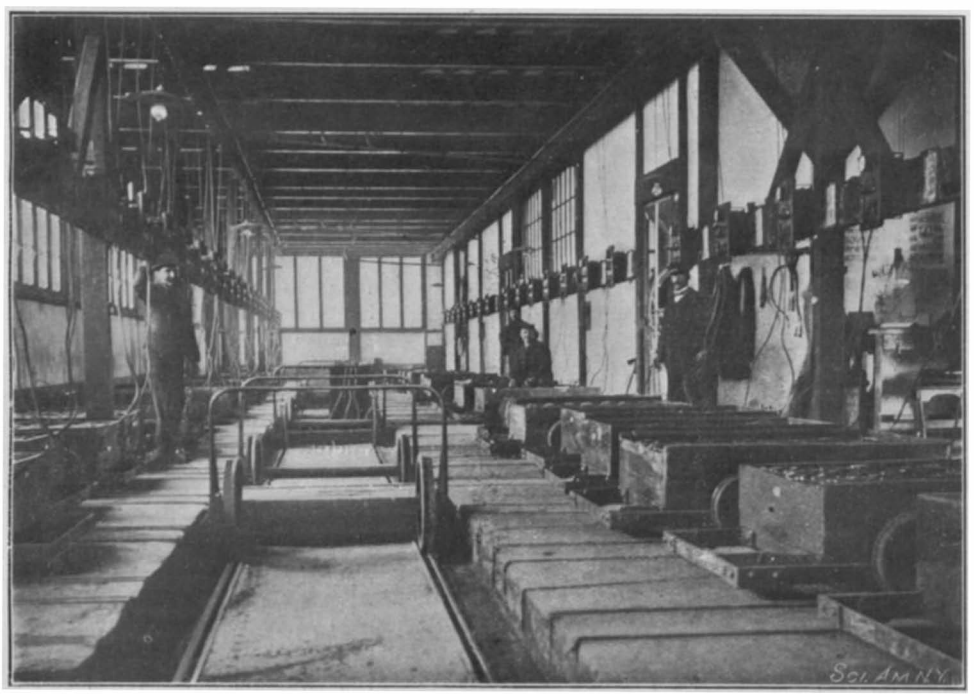
CAB WITH UNDER-HUNG ACCUMULATOR IN PLACE.

pinion seen on the left of the motor is of rawhide, having 22 teeth with steel end-plates, and engages with the large gear wheel of 81 teeth placed upon the crown of the differential. At each end, the shaft of the differential is supported by a long bearing, and carries on its outer end a chain wheel of 19 teeth, seen on the left, which drives the rear axle. The motor is supported on a bronze plate which in the rear is pivoted around a shaft placed in line with the centers of the driving wheels. This plate is supported on its inner end by a coiled spring resting upon a horizontal bar. The different circuits of the motor pass into a series of connecting posts at the top, from which a series of wires pass in front to the controller. The controller is placed under the driver's seat, where it is entirely enclosed. It consists of a small drum with rubbing contacts, of the usual type, placed horizontally. The shaft is provided with a pinion on the left-hand side, engaging with a toothed sector, the latter being connected to a lever on the outside of the box and within easy reach of the hand. The different speeds are obtained by combining the field and armature circuits of the motor. The battery connections remain unchanged. The two electric brakes are also operated by the controller, and the cab has one cylinder brake as well as the ordinary brake shoes, these are arranged to cut off the current when the brake-pedal is applied.

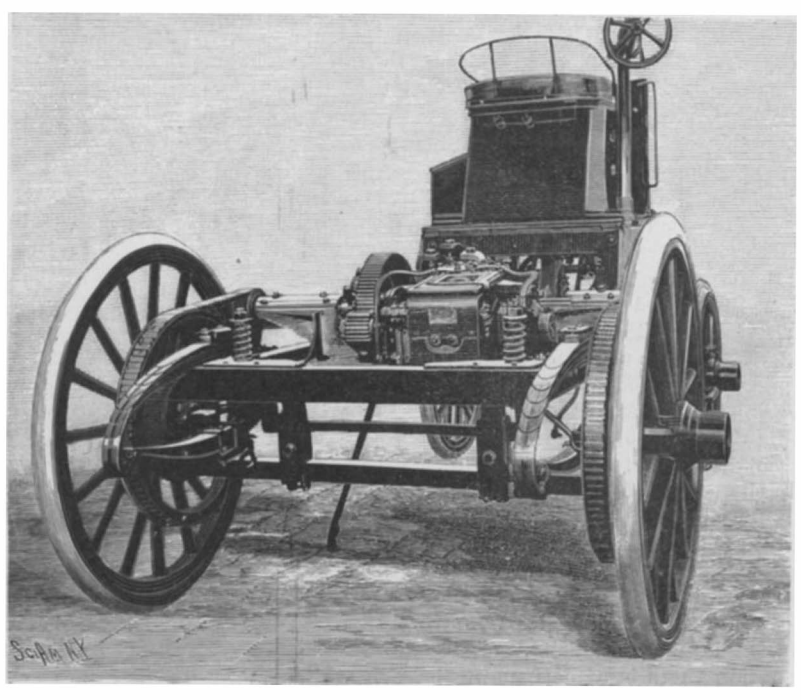
The electrical plant necessary to charge the batteries consists of a boiler room and a dynamo room. It contains two engines of 250 horse power, each driving a dynamo of the Alioth type. The dynamos have each a capacity of 1,200 amperes at 110 volts. From each dynamo four flexible cables of large section pass to the switchboard, which is in a gallery at one end of the station, and from there the conductors lead to the accumulator charging rooms.

The rooms set apart for charging the accumulators form one of the original features of the plant. They are arranged so that the batteries may be easily handled and the operation of charging carried out rapidly. Two charging rooms are provided, one on the ground floor and the other in the second story; the former is shown in the illustration. In the center runs the main track, bringing the accumulator boxes, mounted each upon its truck, to the desired points, where they are rolled out upon the elevated side platform, in front of the charging post. The latter consist of a number of panels placed along the wall above the accumulators, each panel being connected with the main circuit. The current is measured by an ammeter at the top, and the circuit passes to a rheostat below. The panel is completed by a switch and a pair of fusible cut-outs, from which the cables pass below to the accumulators. The lower floor has 54 of these charging panels and the second floor about the same number. The main current is distributed to the charging posts by a switchboard placed at each end of the room, and protected from acid fumes by a glass panel. The rooms, above and below, have cement floors, and tarred wood is used throughout. The accumulator boxes are carried to the second floor by a hydraulic elevator; for this two pumps are provided, each driven by an Alioth motor of 6 horse power.

The type of accumulators used is that controlled by the Société pour le Travail Electrique des Metaux. The elements are of the mixed type, the positive plates being composed of a number of flat and slightly corrugated strips of lead placed one upon the other and soldered at intervals to the central cores and sides of the plate; the negative plates are of reduced chloride of lead, contained in a lead grid; Ebonite cells are used, with a false bottom, and between the plates is placed a thin corrugated strip of ebonite, pierced with small holes. For each cab, 44 cells are used, weighing 750 kilogrammes; their capacity is about 175 ampere hours, and the current taken by the motor varies from 20 to



CHARGING ROOM, SHOWING ACCUMULATOR BOXES AND TRANSFER TRUCKS.



FRAME OF CAB, SHOWING MOTOR AND DRIVING GEAR.

60 amperes, so that a battery should allow a distance of 50 to 60 kilometers. The cells are placed in an iron-bound wood box, which is suspended by four chains, the points of suspension being supported upon springs. The battery has thus a double suspension, taking into account the springs of the cab. The box is prevented from swinging by a system of tie-rods.

The question of replacing the accumulator boxes in the cabs as they come in from service is an important one, as there should be no loss of time in changing the boxes. The cab, as it comes in with its exhausted battery, is brought under the gallery and rolled upon an inclined track. The battery is thus at a considerable height from the ground, and this permits the truck to be rolled under it upon a track arranged for the purpose. Below the cab is a hydraulic elevator, worked by a lever near by, which lifts the truck to the height of the battery; the latter is thus raised, as this permits the uncoupling of the suspension chain and tie rods. The latter is then lowered with its truck to the level of the rails and rolled into the charging house; a fresh battery, also upon its truck, is brought out and put in place by reversing the operation. In this manner the driver is not obliged to leave his seat while the battery is being replaced. During this time the motor is examined and put in order by a lid in the rear of the cab, or by removing the interior cushions of the cab and opening the seat. At present six of the inclined tracks or elevators have been installed.

DR. PUPIN'S IMPROVEMENTS IN LONG-DISTANCE TELEPHONY.

BY HERBERT T. WADE.

Soon after the laying of the first Atlantic cable, nearly fifty years ago, Sir William Thomson prophesied that it would not be possible to exceed a certain rate of speed in the transmission of signals, on account of the so-called capacity of the cable. This prophesy has held good, for notwithstanding multiplex and mechanical systems of telegraphy on land, the submarine cables are operated at an avarage speed of but twenty-five words a minute. The use of a submarine cable in telephony over a greater distance than twenty-seven miles in length (Dover-Calais) is not supposed to be practicable, and consequently telephonic communication is not available where a large body of water must be crossed. In telephone circuits where aerial wires are employed, there are also limitations, and yet long-distance telephony on such a scale as is desired, from New York to New Orleans, or San Francisco for example, has not been attained and is admitted by telephone engineers to be next to impossible.

After a series of experiments performed at the laboratory for electro-mechanics at Columbia University, Prof. M. I. Pupin has ascertained that with cables and air line conductors constructed according to a method thus far employed in the construction of long distance electrical conductors, which involves a somewhat radical but nevertheless a very simple departure from the methods, the efficiency of transmission of electrical energy is greatly increased, and that a number of the difficulties just enumerated may be readily overcome. The method may be stated broadly to consist in employing what Prof. Pupin calls non-uniform conductors in place of ordinary uniform conductors. In the course of his experiments he has made use of such conductors for long-distance telephony, and the researches in his laboratory have been marked with great success.

Electrical energy when sent over a conductor of such length as is used in long-distance telegraphy or telephony is transmitted in the form of electrical waves. The transmission of the energy under such conditions can hardly be called direct for it is first stored up in the medium surrounding the transmission line and from here it is then transferred to the receiving apparatus. If a periodic current is impressed on the circuit by the transmitting generator, we have periodic variations of current and potential along the transmission wire.

In the study of electrical waves it is found that the amplitude of the wave diminishes as the energy is propagated from the source. In short, a weakening of the current is caused which is styled attenuation, and for the constant of attenuation there is a mathematical expression in which the inductance, resistance, and capacity of the conductor, and the frequency speed figure. The loss of energy is due to the imperfect conductivity of the wire, and it is regulated by the inductance and capacity in the circuit. The most important feature of this regulation is the following: If a conductor has a high inductance, a given quantity of energy will be transmitted with less loss than over a conductor with a smaller amount of inductance. This fact was known to Oliver Heaviside, the mathematical physicist of England, and while his theory demonstrated the superiority of a wave conductor of high inductance, it did not indicate a way in which such a conductor could be constructed. The mere introduction into the circuit of a coil or coils has been tried without success, as there was no underlying mathematical theory to govern the experiments.

Prof. Pupin, however, has developed such a theory, which serves to explain the problem, and its main features are well shown in a mechanical illustration in which the same elements are present as are found in the question of the transmission of electrical waves. To one prong of a tuning fork rigidly fixed at *C* is fastened a cord whose other end is attached to some firm object as *D*, shown in the illustration (Fig. 1). Let the fork be set into vibration and a wave motion results, which, if the resistances due to friction are negligible, will take the form of stationary waves, as shown in Fig. 2. But assuming that the frictional resistances are not sufficiently small to be neglected, then the direct and reflected waves will not be equal, and instead of stationary waves there will be waves where the amplitude of the particles at the greatest distance from the tuning fork will be less than that nearer the source of motion, as shown in Fig. 3, the energy being dissipated by the frictional resistances in its progress along the cord. This weakening or attenuation, however, will be diminished if a string of greater density is employed, since a larger mass requires a smaller velocity in order to store up a given amount of kinetic energy, and a smaller velocity occasions a smaller frictional loss. Now let a weight, such as a ball of wax, be attached to the vibrating cord at its middle point so as to increase its mass. This weight will serve to occasion reflections, and there will be far less energy transmitted to the extremity of the string than before. Then, if the mass of wax be subdivided, and put at regular intervals, as shown in the diagram (Fig. 4), the efficiency will be increased. The further we proceed in this subdivision the higher will be the efficiency of transmission, but a point will be soon reached beyond which it is not possible to secure an appreciable improvement by further subdivision.

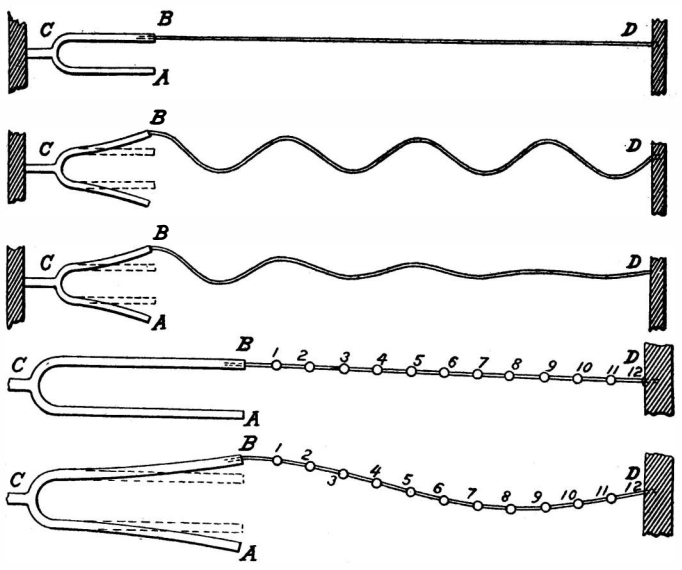


Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Fig 5.

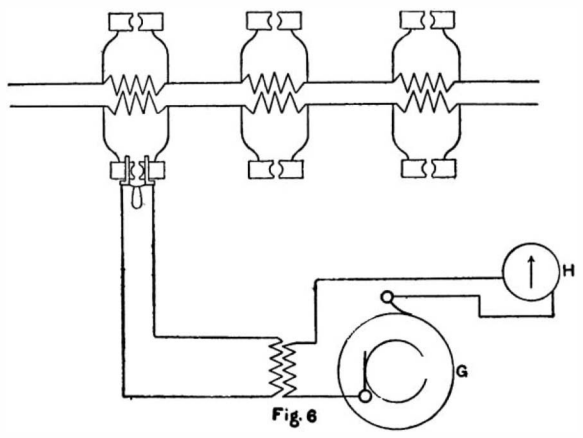
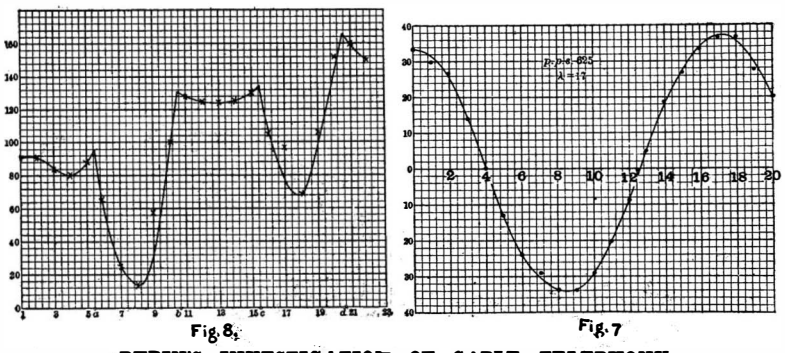


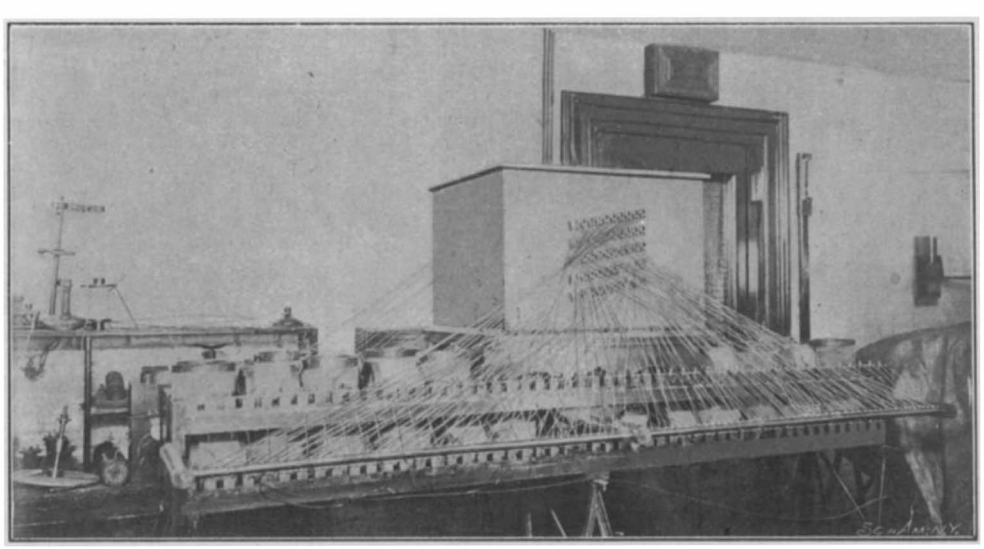
Fig. 6

This point is where the cord thus loaded vibrates very nearly like a uniform cord of the same mass, tension and frictional resistance, as we may see by reference to Fig. 5. Therefore, to secure an increase in the efficiency of transmission over a cord thus loaded, we must properly subdivide the load and the distances, or otherwise the effects of reflection will destroy the benefits derived from the increased mass. In the experiments with the cord it was found impossible to load the cord in such a way as to make it equivalent to a uniform cord for all wave lengths, but if the load was distributed so that it satisfied a given wave length, it also answered for all longer wave lengths. The mathematical theory and law for the vibration of a cord under such conditions is exactly the same as that governing the distribution of the electric current over a wave conductor under the influence of similar forces, kinetic or mass reaction, tensional reaction and resistance reaction in the case of the cord being paralleled by electro-kinetic reaction, capacity reaction and ohmic resistance reaction in the case of the wave conductor. Therefore, it will be understood that if inductance coils are introduced along the wave conductor at periodically recurring intervals, the efficiency of the transmission of electrical energy is increased. Prof. Pupin's conclusion is that a non-uniform conductor is as nearly equivalent to its correspondingly uniform conductor as $\sin\frac{\varphi}{2}$ is to $\frac{\varphi}{2}$, where φ is the angular distance between the inductance points of inductance sources and the angular distance to 2π corresponds with the wave length. Here the value φ is inversely proportional to the wave length, so that for a given distance between the reactance points the degree of equivalence diminishes as the wave length diminishes. If the wave conducted be of complex nature, such as is met with in telephony where the overtones of the voice are present, then, if the approximation suffices for the highest essential frequency, the conditions will be even more favorable for the lower notes.

From theory to experiment was the next step in this investigation, and the study of these electrical waves was undertaken while they were passing over wave conductors. The experimental proof consisted in demonstrating that non-uniform conductors of the description just given will show the same wave-length and the same attenuation for a certain frequency and for all lower frequencies as a uniform conductor of the same inductance, resistance and capacity. The wave-length is of course conditioned by the frequency, and in the construction of the apparatus the periods used in long distance telephony were selected The conductor selected was the counterpart of a cable 250 miles in length, having the equivalent resistance and capacity. To construct such a cable was a task of much labor and



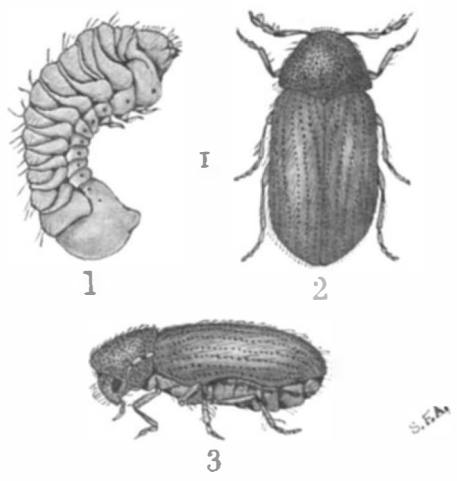
PUPIN'S INVESTIGATION OF CABLE TELEPHONY.



Arrangement of 250 miles of artificial line, with inductance coils at one-mile intervals, and telephonic instruments at either end.

Fig. 9.—EXPERIMENTAL CABLE WITH INDUCTANCE COILS.

three cables were made and experimented with, before the final form was reached which approaches very nearly the conditions existing in a submarine cable. This was formed of thin strips of tin-foil laid on sheets of paraffined paper and carefully connected, their length being sufficient to afford considerable resistance, while the capacity was regulated by the thickness of the insulating material. The strips were then connected in sections, each being equivalent to one mile of cable with a resistance of 9 ohms and a capacity of ·074 microfarads, and were arranged in



THE STORE-ROOM BEETLE.

1. Larva. 2. Beetle (dorsal view). 3. Beetle (side view).

groups of fifty, one such group being contained in the heavy case shown in the center of the illustration, Fig. 9. Having a cable where there is resistance and capacity, it is possible to demonstrate experimentally the vigorous attenuation of the current and to study the propagation of the electrical waves. This attenuation, as has been said, is remedied by the insertion of inductance coils into the circuit, and the illustration and diagram show the method of adding such coils. The wires from the various sections of the cable are connected with brass plates placed on a long wooden strip and by means of plugs and binding posts the circuit can be regulated. At the gap between any two successive sections of the cable a coil or coils containing inductance can be added, and by merely inserting a plug can be cut out of the circuit. Using a small alternator, and circuits with suitable inductance and capacity, to impress a simple harmonic electromotive force the waves were investigated. The alternator was so constructed as to give currents of different frequencies and thus produce the circuit waves of different length. Then with a slide contact, *G*, and galvanometer, *H*, arranged as shown in Fig. 6, it was possible to assertain the condition of the current at any point along the line. In this way observations were made and curves plotted showing the maximum and minimum amount of current and the length of the wave passing along the conductor. Such a curve is shown in Fig. 7, the numbers along the horizontal line in the middle representing the distance from the middle point of the cable, and the dots the current at various distances from this point.

Connecting these points we have a close approximation to an attenuated sine curve as required by the mathematical theory. In this case the wave length is 17 miles and the frequency 625 periods per second. Contrast this with the following illustration where the inductance is not properly placed in the circuit, and the result shows a remarkable attenuation and reflection of the waves. Leaving the exact mathematical considerations out of the question it may be stated if the induction coils are placed at intervals about one-sixteenth of the wave length the non-uniform conductor will be like a uniform conductor to within two-thirds of one per cent. If this is done the attenuation is made very small, comparatively speaking, and the electrical energy is transmitted with but slight dissipation. A numerical example will illustrate this more clearly. If the cable is employed with the inductance coils placed properly, then two and one-half per cent of the current generated at the transmitting end reaches the receiving end of the cable. But if the coils are cut out and the cable used in the ordinary way, then only one two hundred and fifty thousandth part of the current sent in at the transmitting end reaches the receiving end. In other words the insertion of the coils enables the cable to transmit 6,000 times as much current.

The first application of the results of this investigation has been to long-distance cable telephony. The cable being employed as before with the inductance coils at intervals of one mile, and at either end of the line two sets of ordinary telephonic instruments. Over this line of 250 miles of cable one can carry on a conversation distinctly, the fact seeming the more remarkable when it is realized that about 40 miles is the present limit for cable telephony and that the longest cables in the New York subways are 15 miles in length. These experiments from a purely scientific point of view demonstrate the feasibility of trans-Atlantic telephony.

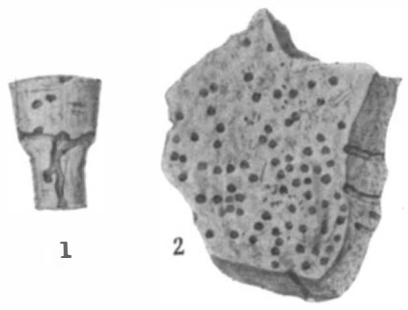
It is, however, in regard to its applicability to telegraphy, that its advantages for marine work must be especially considered, where, as soon as the speed is increased the attenuation of the waves occurs and a limit is very early set upon the rate of operation. With the attenuation taken care of by inductance coils added at specified distances along the cable, the current would be transmitted with small loss to its destination and not only would the ordinary speed of operation be increased, but by the use of methods similar to those employed on land for rapid telegraphy the efficiency would be made many times greater. The inductance coils could be added to the conductor at certain distances and placed within the sheathing at small expense in comparison with the cost of the cable, and being made about one inch in diameter and six inches in length would create no particular difficulty either in the manufacture or in the laying of the cable.

The earliest application of this method will doubtless be to aerial conductors to increase the present limits of long-distance telephony now placed at St. Louis from New York. The inductance coils at slight cost can be attached to the cross arms of the poles and instead of the heavy copper wires now required, a smaller and less expensive conductor may be used. According to the theory and its expermental verification, there seems to be nothing to prevent a very wide increase in the limiting distance of modern telephony through the use of this method of constructing conductors, and trials in the field under actual conditions of service are anticipated with interest by telephone engineers. It is worthy of notice in connection with this discovery that its entire development has been carried on along strictly scientific lines by Professor Pupin, to him being due the conception of the mathematical theory involved, its experimental verification, and lastly its application to an important technical problem.

THE STORE-ROOM BEETLE OR BOOK WORM.

BY S. FRANK AARON.

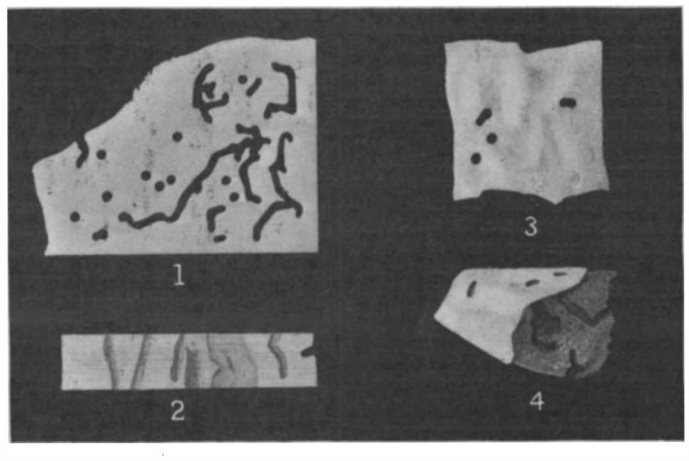
The subject of the present paper, the "store-room" or drug store beetle, is quite cosmopolitan, being



WORK OF STORE-ROOM BEETLES.

1. Cork of bottle of destroyed silk worms. 2. Perforated oil cake.

found in the torrid as well as temperate regions of both hemispheres. It is by no means confined to drug stores, but has been given that name because it is frequently found in materials and products stored and sold by the druggist. While it attacks many animal substances, there is hardly any limit to the number of vegetable materials in which it works. Remarkable



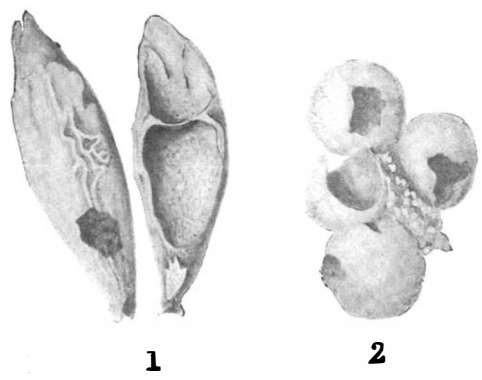
WORK OF STORE-ROOM BEETLES.

1. Paper bored by larvæ and beetles. 2. Section of book bored. 3. Tinfoil bored by beetles. 4. Pieces of chocolate covered by tinfoil, showing borings.

instances of its voracity and destructiveness are on record. The writer received from Japan ten bottles of silk worms that had been preserved in alcohol. The alcohol had evaporated from nine of the bottles, and the corks in each had been tunneled through and through and the silk worms turned to dust by these beetles. If the shrunken corks permitted the alcohol to evaporate, they would also allow the odor of the dried insects to reach the outside air, and thus the beetles were attracted.

A still more amazing instance follows. Several pounds of chocolate were received, each cake wrapped tightly in tin-foil. In nearly every package the tin-foil had been extensively perforated by these beetles, the chocolate was riddled, and much of it pulverized. Of course the odor of the chocolate could not escape directly through the foil, but must find an outlet through its folds. It was noticed that but few beetles were found in the cakes in proportion to the number that must have wrought the damage, and that the edges of the holes in the tin-foil were turned outward more than inward, suggesting the idea that most of the beetles had entered between the folds and had emerged directly through the tin. True, the metal is exceedingly thin, yet it must present a serious obstacle to a tiny insect of not more than six or eight times its thickness.

A set of six books in paper binding was received from Brazil, including three different kinds and colors



WORK OF STORE-ROOM BEETLE.

1. Barley grains entered and the interior eaten. 2. Sorghum seed bored into and destroyed.

of paper. These were bored through and through, the covers, pages of text, and plates being alike attacked; in some places the beetles working edgewise or diagonally through the leaves and excavating good-sized holes. In all cases the print was entirely avoided, only the margins and the parts about the pasted or glued backs receiving the injury.

Herbarium specimens of plants, seemingly without reference to species or condition, are subject to attack by these beetles. In such cases they not only perforate and eat away the dried plants, but also the paper upon which the plants are mounted. A sample is before me in which the one-time presence of the plant is indicated only by the dusty outline on the paper, which is bored through in many places. They are said also to attack manuscripts, drawings and gun-wadding.

No insect of the household or store room is as generally injurious as the drug store beetle. Such pests as the cockroach, the red ant, the rice weevil, and the woolen moth may be more in evidence, but their scope is far more limited and their ravages are more readily checked. The drug store beetle is the smallest of them all, but it makes up in its enormous numbers what it lacks in size. Its omniverous appetite is strikingly shown by another test. I recently reared several generations of these beetles in a small jar of ground pepper. They flourished there in the best of health, and they increased in numbers until finally the jar contained all beetles and scarcely a remnant of pepper dust.

To the scientist this beetle is known as Sitodrepa Panacea, a name given because the insect was first found in dried bread. It belongs to the family Ptinidæ. It is of a reddish brown color and varies in length from one-twentieth to one-tenth of an inch. The head is situated beneath the pro-thorax, the legs are slender, the body compact and rounded, and the motions rather slow. The larva is whitish yellow with black jaws, the pupa whitish, and the pupa case or cocoon is formed out of the dust of the larval borings. In an equable summer-like temperature the transformation lasts about eight or ten weeks, and in heated buildings there may be four or five broods annually.

The Current Supplement.

The current SUPPLEMENT, No. 1274, is an unusually interesting number. The leading article is devoted to the "Manufacture of Candles" and is accompanied by fifteen engravings. "The Murnau-Oberammergau Railroad" describes the new road leading to the scene of the Passion Play, and the play itself is also described. "The Art of the Paris Exposition and Some of its Buildings" is an elaborately illustrated article.

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RECENTLY PATENTED INVENTIONS.

Agricultural Implements.

CHECK-ROW CORN-PLANTER. — CHARLES M. DAYTON, Bowling Green, Ky. The purpose of the invention is to provide a planter which will drive stakes to mark the end of a row. The stake-setting mechanism is automatically actuated; the machine plants without the use of a wire. The invention consists essentially of a planter provided with stake-holders, mechanism for planting corn and fertilizer together in hills at regular intervals, and means whereby the mechanism for planting will automatically actuate the stake-holders to release and drive the stakes in order to mark the end of a row.

PLOW. — MICHAEL BYSTROM, Centerville, S. D. The plow has a mold-board provided with fingers which can be quickly adjusted, so that any undesirable material upon the field (weeds, long stubble, straw), can be covered up, whether the ground be loose, dry or wet. The plowshare is so constructed that it will produce a straight, well-defined cut. The point remains sharp for a long time, so that the land-side is subjected to but little pressure.

Mechanical Inventions.

EXHIBITING-MACHINE — JOHN HEISSENBERGER, Bronx, New York city. This machine is designed to exhibit illuminated pictures and to provide music during the exhibition, and to distribute photographs or other articles before or after the exhibition of the pictures, all the parts being controlled by a common motor, set in motion by a coin. The picture-carrier and cylinder of the music-box are automatically stopped and the light employed for illumination extinguished as soon as the first picture exhibited is again brought before the lenses. Comparatively few parts are necessary to perform these various functions. The machine is simply and durably constructed, and is so arranged that but little space is occupied.

PULVERIZING AND SEPARATING MACHINE. —CHARLEL W. DAY, Santa Cruz, Cal. This mill is designed to extract precious metals from their ores, particularly from talc, talcose, slate, and clay. The inventor employs crushing-rolls which travel in a circular trough containing the ore and a suitable quantity of mercury for amalgamating purposes.

CLOTH-CUTTER. — ROBERT PHILLIPS, 330 North Charles Street, Baltimore, Md. The cutter is an improvement in machines which are manually guided upon a table or other flat support for the cloth, and are driven by a steam, air, or electric motor. Heretofore a single knife has been employed, arranged to reciprocate vertically. The inventor, however, uses two cutters working parallel, but out of contact, and making a circular movement by which they make a draw cut in the cloth and thus do rapid and effective work. The two cutters are separated by a thin, flat plate, with whose opposite sides they work in contact. Being beveled exteriorly, the cutters are, to some extent, sharpened by friction with the plate and cloth.

FLUID-PRESSURE PRESS.—RUDOLPH RUETSCHI, Argentine, Kans. The object of the invention is to provide a machine for pressing dry and wet materials into bricks, the machine being completely automatic in its operation and arranged to form articles of a uniform and predetermined strength, the controlling power being air or steam under pressure. The motive agent actuates a piston in order bodily to move a mold, so as to compress the material against a fixed platen and form the brick. The air or steam is then allowed to actuate secondary devices under reduced expansion to remove the finished article, fill a second batch of material into the mold, cut off the initial pressure, release the actuating devices at the proper time to bring them back to a normal position, and again turn on the initial pressure in order automatically to repeat the cycle.

TRUCK-HAULING DEVICE. —FRANCIS H. WEEKS, Bronx, New York city. In unloading vessels, it is necessary for a truckman to draw the loaded truck from the deck up an inclined gangway to the pier. It frequently happens that the gang-planks are considerably inclined, so that it is extremely difficult to haul a load up the plank. A number of men are, therefore, located along the plank, so as to help the truckman. By using a mechanical conveyor, Mr. Weeks dispenses with the extra longshoremen, and the truckman has merely to guide the truck while on the gang-plank.

TRAP-GUN.—ADOLPHUS H. FORSTNER, Salem, Ore. The purpose of this invention is to furnish an improved trap-gun which can be handled and set with perfect safety, and which is designed to kill gophers and like animals. The firing-pin is manually placed in operative and inoperative position. When in inoperative position it is held against movement by the hammer to prevent accidental firing of the gun, even if the hammer strikes the pin.

BRICK-MACHINE.—RUSSELL ANTHONY, Wortham, Tex. The inventor has devised a simple, automatic machine designed to receive bricks from a stiff-mud mill and to repress them. The machine is so constructed that the bricks to be treated will be fed to the machine by a suitable conveyer and conducted one after another to the press-box, released from the pressure of the box and its follower, and removed from the box to a second conveyor, which will conduct the finished bricks to any desired point.

PNEUMATIC PUMPING-DEVICE. - LEVI M. BROCK and GEORGE W. PHILLIPS, Mackinaw, Ill. The invention is an improvement in devices for pumping water, using compressed air as a motive force, and is composed of two alternately-operated cylinders, which are placed to receive a gravity-supply of water to which separate air-supply pipes lead. A double-cylinder air-pump is also used, each cylinder being connected with one of the pipes supplying the water-pumping cylinders. Valves, provided with a tubular central portion, have their ends inserted in casings and have ports adapted alternately to connect both pipes from the compressing cylinders with one pump-supply pipe and to discharge the air from the other pump-supply pipe. A valve-operating mechanism is actuated by the compressor-actuating means.

Railway-Appliances.

CAR-DOOR.—GEORGE M. CARTER and ALEXANDER W. DAVIDSON, Poplar Bluff, Mo. The invention relates to box freight-cars; and its object is to provide a new car-door arranged to be flush with the side of the car when closed and to render the car rain and dustproof at the door-opening. The door has one side and one end formed of movable members, a lever, and links connecting the lever with the members to move them simultaneously in the plane of the door in an inward and outward direction. The door can hence be opened and closed with very little physical effort.

Miscellaneous Inventions.

VEHICLE-BRAKE.—CHARLES W. LOOMIS, Otisville, N. Y. The purpose of the present invention is to provide a vehicle-brake of that class in which the brake may be hung from the body of the vehicle or otherwise supported. The invention embodies certain special combinations by which, when the brake is hung on springs, it is possible to apply it with a force increasing with the load on the vehicle, so that when the load is great the brake will be applied with much force, and so that when the load is light the force of the brake will not be so great.

FILTERING-STOPPER. — ISIDOR LAMBERT, Rue des Pyramides 14, Paris, France. This perforated, hollow stopper contains filtering material, so that it can be used on milk-bottles, jars, and flasks for purifying water, milk, and the like. The filtering stopper enables the soldier, for example, rapidly to fill his can with water, regardless of its quality; and this water is purified as he drinks it. The suction necessary to draw the water into the mouth causes the water to pass through the filtering substances contained in the stopper.

UNDERCHECK DEVICE FOR HORSES.—GEORGE A. KELLY, Dayton, Wash. The inventor has devised an attachment for a bridle which will render it unnecessary for the horse to be unduly checked up and which will likewise prevent the horse's pulling too strongly upon the reins or choking. One bit only is required; and the chin-straps and nose-band may be dispensed with.

HEATING APPARATUS.—DAVID M. HORTON, Fishkill, N. Y. The purpose of the present invention is to provide a heating apparatus by which hot air can be supplied to the higher rooms of a house by heat derived from the chimney-flue. The invention is principally characterized by novel constructions of the hot-air flue, which cause it to be more effectually acted on by the heated gases in the chimney-flue, thus to increase the efficiency of the apparatus.

OIL-FILTER.—GEORGE W. GALLAWAY, Rye, N. Y. This oil-filter for bearing-drippings and the like, comprises a body portion divided into a water-chamber and a precipitating-chamber. A funnel is removably arranged in the water-chamber and has its stem portion extended nearly to the bottom. Filtering material is arranged in the funnel. A precipitating-pan is removably arranged in the precipitating-chamber; and to this pan the oil is directed through the water-chamber. An outlet-tube is extended from the top of the pan and through its bottom. A filtering-device is located below the pan; and above a chamber for receiving the filtered material.

MEANS FOR CONTROLLING HORSES. — GÉZA EGYESY, Buda-Pesth, Austria-Hungary. The inventor has devised a means for arresting horses, should they become violent when in harness. He employs straps connected with the bridle and reeved through guide devices on the thills, the straps passing to the vehicle, where they may be reached by the driver when necessary.

EJECTOR-PUMP. — CHARLES A. DRYER, Champaign, Ill. This pump is especially adapted to deep-driven wells and comprises special features of construction by which a fluid-jet can be effectively employed as the motive-agent. The pump has a valve-casing in which is a passage commanded by a valve. A head is attached to the casing and is composed of a chamber having communication with a source of fluid-supply, and of a passage conducting a jet of fluid from the head. As a partial vacuum is created in the well-tube above the valve-chamber, the water is drawn through the valve-chamber and forced up the well-tube.

ENVELOP.—MILLARD J. DENNIS and WILLIAM C. DAVIS, Nevada, Tex. The envelop is particularly adapted as a cover or wrapper for valuable papers, money, and the like, and is so constructed that its contents are thoroughly protected, and that it can be traced from one forwarder to another and identification be established at the point of destination.

CONCENTRATOR. — EDSON F. DAVIS, Wetmore, Colo. The ore-concentrator comprises a frame in which an inclined table is hung and pivoted. The table can be given a bumping reciprocating motion. A feed-hopper discharges the material upon the upper end of the table and at one side. Riffles on the table extend partly straight in a longitudinal direction below the feed-hopper and partly curved in an upward and transverse direction. A trough on the lower front end of the table receives the tailings; and a trough on the upper rear end of the table at the discharge end of the curved parts of the riffles receives the gold.

MEAT-COOKING DEVICE.—ADAM REUBOLD, Manhattan, New York city. This device has a barrel-shaped body with open ends, arranged to contain the article to be cooked. A closure for the body presses and incloses the article at the sides. The contrivance is designed for cooking hams. The ham is inclosed in wood, so that the meat is not injured by coming into contact with the metal parts.

PAPER-BOX.—JOSEPH T. CRAW, Jersey City, N. J. The invention provides a means whereby a paper-box can be rendered siftless at its end or flap section, thus providing a package in which granulated sugar or like material can be packed and shipped without danger of the contents' spilling, even when the package is subjected to severe usage.

ICE-CREEPER.—ROBERT C. SNOWDEN, Duquesne, Penn. The ice-creeper is composed of a length of suitable wire which is bent to form a spring-clamp adapted to clamp or embrace the ball of the heel. Spurs are provided for biting into the ice or sleet. The device is light and can be readily carried in the pocket and conveniently applied for use whenever desired.

BOLT-LOCK.—PAUL O. E. BOUDREAUX, Theriot, La. The invention comprises a bolt having a tapering screw-threaded bore in one end and equidistant tapering slots dividing the bore into sections. Each of the sections thus formed is provided with a shoulder. A tapering screw is arranged to work in the bore and is formed with a head and a transverse opening therethrough below the head. The opening is adapted to receive a key which projects beyond the screw to engagement with the side walls of two opposite slots when the screw is in place in the bore.

SAILING CRAFT.—DOUGLAS BEARDSLEY, Auburn, N. Y. The invention is an improvement upon sailing craft provided with swinging ballast. In a former arrangement patented by the inventor a mast was employed stepped in a pivoted socket and connected with the ballast so that when the mast inclined, resistance was offered by the ballast and not by the hull of the craft, which remained in normal vertical position. The present invention embodies improvements found necessary in actual practice, these improvements being designed to obtain a quick lateral movement of the ballast to prevent the wind's "spilling."

ACETYLENE GAS GENERATOR. — WILLIAM F. COOPER, Meriden, Conn. The apparatus is designed to feed the carbid intermittently to a subjacent body of water and automatically to renew that body of water, and discharge the slush into a sewer or other convenient receptacle. The device precipitates into the generator a large flushing volume of water, whose flow, when started, continues from an elevated reservoir independently of any subsequent motion of the gasometer; and the discharge-pipe opens directly from the bottom of the generator and rises to a point outside in a relatively small cross-section. This causes a forceful flow of water to issue from the bottom of the generator, so as to carry out the slush.

HEAD-GATE LOCK.—JOSIAH L. RHEAD, Corinne, Utah. This invention relates to locking devices for the head-gates of irrigating ditches, canals, flumes, and waterways, constructed in such a manner as properly to protect the interests of both the supply company and the consumer. It is desirable in the interests of the company that the head-gate should not be opened more than a limited distance to admit the amount of water which the consumer contracts for; and yet the consumer frequently desires to be able to cut off the water or reduce the flow. The present invention provides a single gate which can be locked by the supply company at its limited opened position and yet be perfectly under the control of the consumer in every range of adjustment less than the maximum and down to the point of closure.

GRAIN-CONVEYER.—CHARLES A. SCOTT, Broughton, Ill. The apparatus is especially designed for conveying grain from an elevator to cribs or bins. It comprises a bed constructed of end and intermediate sections separately connected. On the bed are driving-shafts, one of which is detachable. An endless conveyer is propelled by the shafts; and the lower lap of the conveyer has a guide-box. Vertically-movable bearing-brackets are attached to the front end section of the bed. The conveyer-bed can be shortened when necessary, by taking out one or more intermediate sections.

SIPHON WATER-ELEVATOR.—WALTER S. JEWELL, 534 Albion Street, Oakland, Cal. The invention is in the nature of a water-elevator, operating on the principle of the siphon and arranged to take water from a given level and to raise a portion of it to a higher level with no other aid than the useful fall or difference in level between the entrance and exit points of the siphon. It consists in the construction and arrangement of a siphon designed to operate as described. The invention is distinctive in so far as it does not employ pressure and momentum, but rather the principles of suction and gravity.

BINNACLE AND STEERING STAND.—WALTER T. STANWORTH, Norfolk, Va. The invention consists, broadly, in a combined steering-stand provided with a wheel and with an extension above the wheel, upon which extension the compass is placed. The steering-wheel and compass are carried by the same stand; and the steering-stand is provided with the steering-wheel and with the compass above and concentric with the wheel.

PROCESS OF MAKING GAS.—EMIL PILOUS, Vienna, Austria-Hungary. The process is intended to produce a white illuminating-gas by a new carbonizing method, from sweepings of houses, markets, and streets, residue of petroleum, of wood, and of coal, and other waste products. The gas is produced by the distillation of waste material and is conducted in a crude impure state through a carbureter containing calcium-carbid salts. The illuminating power is obtained, not simply by the admixture of acetylene gas, but principally by the removal of the carbon dioxid and pyro-pneumatic substances from the gas to be enriched. The intrinsic merit of the invention consists in placing the carbureter between the retorts and the gas-reservoir, so that the crude, impure gas must pass through the carbureter.

STROPPING MACHINE.—WILLIAM H. DOUGLAS, Belleville, N. J. This machine, for sharpening razors and other knives, consists of a frame in which a shaft is journaled. A blade-holder, secured on the shaft, extends alongside the roller. Gearing connects the roller and blade-holder shaft, so that upon rotating the driving-roller in one direction, a swinging motion is given to the blade-holder in an opposite direction. A spring is connected with the gearing and adapted to be compressed thereby. By the resiliency of the spring, the edge of the blade is caused to be moved out of engagement with the strop surface at the end of the stroke.

Designs.

FISHING-ROD TIP.—ARTHUR L. CLEAVER, Manhattan, New York city. The tip has a shank fitting on the end of the rod and a grooved head having flanges between which a wheel is held, over which the line runs.

CURTAIN-POLE RING.—JOHN KRODER, Manhattan, New York city. The leading feature of the design consists of depending eyes at the ends of a split ring.

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NEW BOOKS, ETC.

INDIA RUBBER, GUTTA PERCHA AND BALATA. By William T. Brannt. Philadelphia, Pa.: Henry Carey Baird. 1900. 12mo. Pp. 328. Price $3.50.

The present volume deals with the occurrence, geographic distribution and cultivation of rubber plants the manner of obtaining and preparing the raw materials, modes of working and utilizing them including washing, loss in washing, maceration, mixing and vulcanizing rubber and gutta percha compounds. The literature upon the rubber industry is so extremely limited that any work devoted to it is doubly welcome, even if it were not of the valuable nature of the present book. A careful examination of the book shows that the information contained in it is of great value and deals with the subject of experimenting upon rubber on a considerable scale. The publishers will send the book postpaid to any address in the world.

ETHNOLOGY. By Dr. Michael Haberlandt. London: J. M. Dent & Company. New York: The Macmillan Company. 1900. 16mo. Pp. 169. Price 40 cents.

One of the "Temple Primers," which provide in convenient and accessible form the information which is usually only conveyed by bulky, high-priced cyclopedias. It is an admirable idea and the volume before us is an excellent example of good and cheap bookmaking. The text is good.

INORGANIC EVOLUTION AS STUDIED BY SPECTRUM ANALYSIS. By Sir Norman Lockyer, K.C.B., F.R.S. London and New York: The Macmillan Company. 1900. 8vo. Pp. 198. Price $1.75.

The author occupies an unique position in the scientific world and anything from his pen is sure to be excellent. The present volume contains an account of the author's most recent inquiries into the chemistry of the stars, and of some questions which have grown out of these inquiries. It is an important treatise concerning the evolution of the chemical elements; and points out especially that the first steps in this evolution may possibly be best studied by and most clearly represented in the long chain of facts now at our disposal touching the spectral changes observed in the hottest stars.

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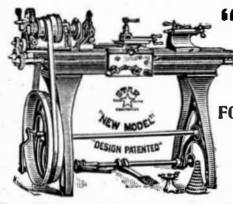

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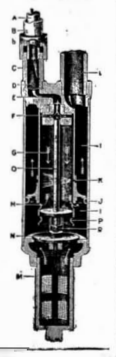

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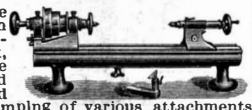

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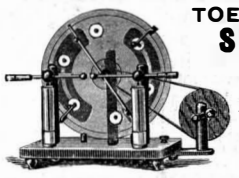

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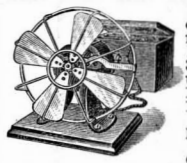

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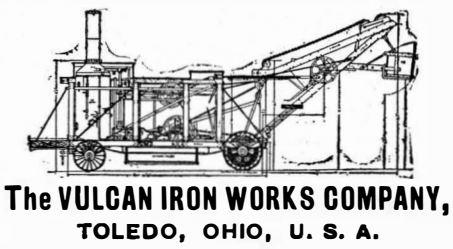

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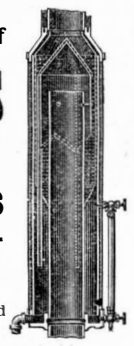

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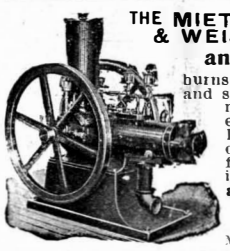

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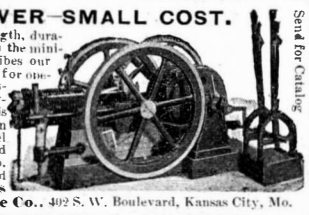

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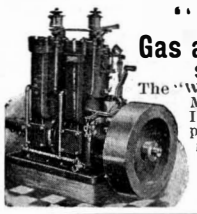

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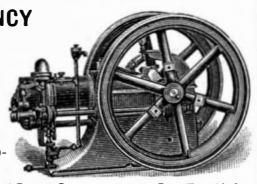

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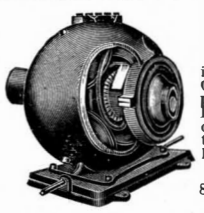

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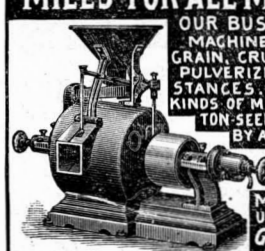

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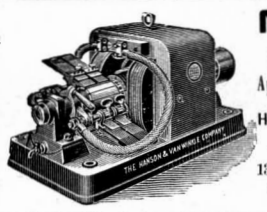

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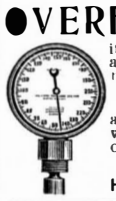

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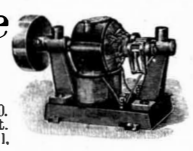

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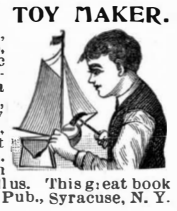

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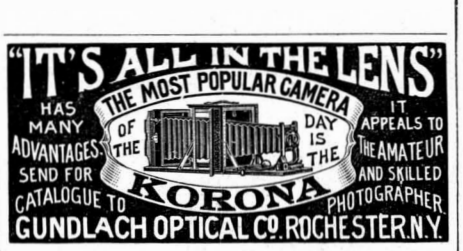
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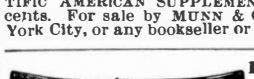

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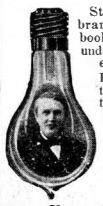

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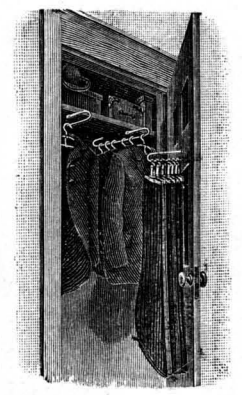

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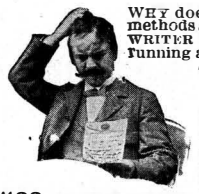

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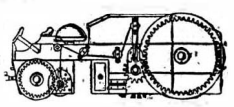

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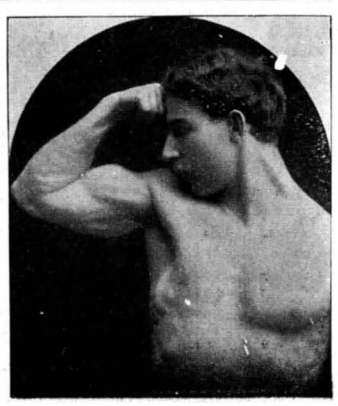

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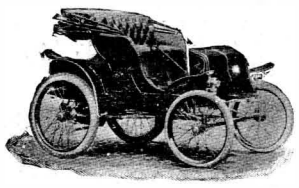

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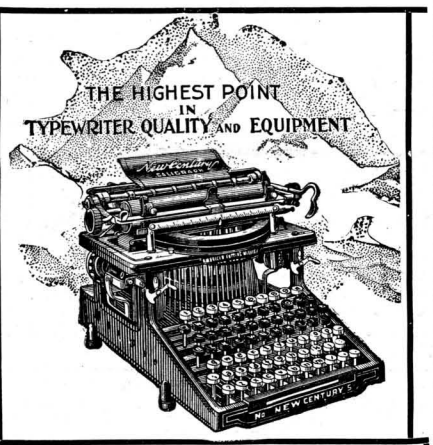

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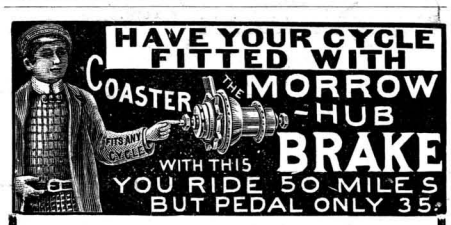
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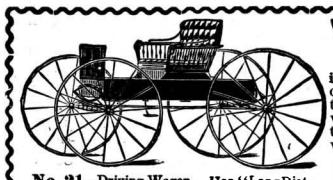

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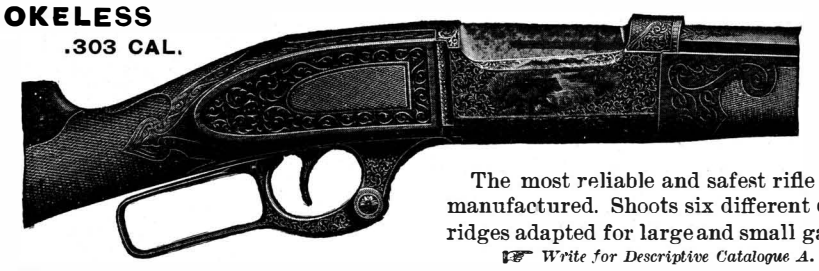

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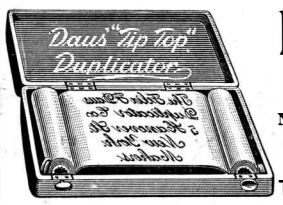

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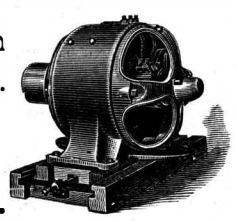

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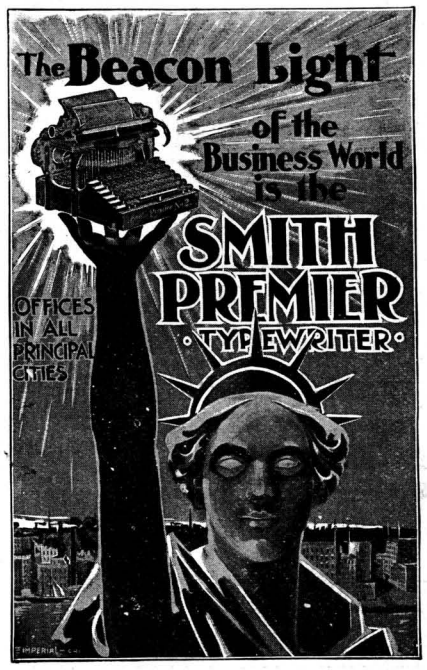

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